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ABSTRACT

This selection of the papers presented at a conference includes 6 introductory papers, 32 papers dealing with innovations and experiences in the authors' own countries, and reports from 6 working groups. These working groups addressed the six key topic areas of the conference: (1) relationships between new technologies and labor relations and their impact on the labor market, education, and schooling; (2) new technologies in the learning process; (3) technology's impact on relationships between general education and education for careers; (4) technological demands upon recurrent education, adult education, and non-formal education; (5) technological developments and their impact on education in the Third World; and (6) the impact of technological developments on both initial and inservice teacher education and training. The majority of the papers are in English, although six are in French and one is in German. (RP)

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THE IMPACT OF TECHNOLOGY ON SOCIETY AND EDUCATION

A COMPARATIVE PERSPECTIVE

L'IMPACT DE LA TECHNOLOGIE SUR LA SOCIETE ET L'EDUCATION

DANS LA PERSPECTIVE DE L'EDUCATION COMPAREE

DIE TECHNOLOGIE UND IHRE AUSWIRKUNGEN AUF GESELLSCHAFT UND ERZIEHUNG

EINE VERGLEICHENDE PERSPEKTIVE

PROCEEDINGS OF THE 12TH CESE CONGRESS

EDITED ON BEHALF OF THE COMPARATIVE EDUCATION SOCIETY
IN EUROPE BY HERM VAN DAELE AND MARC VANSTEENKISTE

ANTWERP 1-5 JULY 1985

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FOREWORD BY THE EDITORS

This volume contains a selection of the papers presented at the 12th Congress of the Comparative Education Society in Europe (CESE), held in Antwerp (Belgium) in July 1985.

The 12th CESE Congress was organised by the Dutch-speaking Society for Comparative Education (Nederlandstalig Genootschap voor de Vergelijkende Studie van Onderwijs en Opvoeding - N.G.V.O.), the University of Antwerp, more particular by the Department of Teacher Training, and the Executive Committee of CESE.
The 12th CESE Congress was given over to 'The impact of Technology on Society and Education: A Comparative Perspective', a theme attracting the attention not only of comparatists, but also of educationists and researchers in other disciplines all over the world. The names and institutes mentioned at the end of the present volume testify to this.

After nearly 25 years of CESE activities a certain routine has been established. Nevertheless, the 12th CESE Congress in Antwerp made room for certain innovations. First, all the participants obtained a pre-congress reader, containing papers specially written for the occasion by members of, and offered by, the Dutch-speaking Society for Comparative Education.
Secondly, the general structure of the Congress had been modified. The Congress started with a few introductory sessions. Well known plenary speakers were invited for this occasion, because a summary of the technological developments in the eighties appeared necessary. Only after analyzing what is new since the Second World War and after making clear what technological development really is, will it become possible to make predictions for the future.
Within this framework Prof. T. Plomp (Technical University of Twente, The Netherlands) spoke about 'Perspectives of new technologies in education', Dr. G. Neave (European Cultural Foundation and since this year professor at the University of London Institute of Education) held forth on 'Socio-economic implications of new technologies', and Prof. R. Dore (Institute for Development Studies, University of Sussex, United Kingdom) read a paper on 'Technological developments and their impact on society and education in the Third World'. Prof. H. Thomas (Technische Hochschule, Berlin, B.R.D.) was also invited as plenary speaker, but unfortunately sickness kept her from attending. During the closing session Dr. L. Cerych (European

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Institute of Education and Social Policy, Paris) presented his views on 'Technology and Education'.

After these introductory sessions the interactions between society, technological developments, education, and policy were brought into focus within the various working groups. This interaction is also expressed in the title of the CESE Congress itself.
In view of the potential impact of the new technological developments on society it was obvious to deal with topics such as labour market, spare time, and civilian living patterns, values, and norms.
The possible influences of technological developments on education involve many different problems. There is an influence on institutional education, with problems specific to general education and to vocational training. The area of non-formal education is becoming more important and presents specific possibilities and dangers. And of course the influence of the computer on the micro-level of classroom practice is at the moment certainly the problem field most intensively studied. The more these developments are making themselves felt in society, the greater will be the need for preparing teachers to cope with these new technologies in classroom practice.
Without losing our enthusiasm for educational innovation we always have to keep in mind the restrictions and risks of technological developments: the possible negative consequences for society, for interaction between individuals and groups, and between industrialized and developing countries. New technologies do not necessarily constitute the right path towards real development, since developing countries have their specific technology and any large-scale import of Western new technologies needs to be considered critically.

The whole complex of problem fields was approached by means of setting up various working groups. Each of these had a group co-ordinator, who prepared the activities of his particular group. The papers printed in this volume are given in the same sequence as that in which they were presented in the respective working groups:

1. Relationships between: technology, labour relations and the labour market, education and schooling. Group co-ordinator: Prof. D. Kallen
2. New technologies in the learning process. Group co-ordinator: Prof. M. Laeng
3. Technology's impact on relationships between general education and education for careers. Group co-ordinator: Prof. J.L. Garcia Garrido

4. Technological demands upon recurrent education, adult education, non-formal education. Group co-ordinator: Prof. E. King
5. Technological developments and their impact on education in the Third World. Group co-ordinator: Prof. M. Debeauvais
6. The impact of technological developments on teacher education and training, initial and in-service. Group coordinators: Prof. W. Decoo and Prof. G. De Corte

A total of more than 50 papers was presented during the Congress. Unfortunately it was not possible to publish all contributions, owing to financial and practical circumstances. The editors had to select on the basis of the following criteria. Only papers relating directly to the Congress were retained. Secondly, those papers which were really comparative in character, containing and discussing data from various countries, are also published in this volume, while the specific topics and countries are also balanced off against one another, to obtain, what the editors hope will be, an interesting publication from an academic point of view.

On behalf of the CESE Committee and of the Organising Committee we would like to thank all those who took part in the organisation and the activities of the Congress; without their participation and contributions the Congress would never have been successful. The co-operation and understanding between the various representatives of CESE, N.G.V.O., and UIA need also to be stressed. A word of special thanks to the University of Antwerp for its very generous support before, during, and after the Congress is also in place here. No participant will deny that the reception and infrastructure of the University have contributed in a large measure to the success of the various scientific and cultural activities.
We would like to thank also the Flemish Ministry of Education, the 'Nationaal Fonds voor Wetenschappelijk Onderzoek', the University of Antwerp, the British Council, I.B.M., and the 'Generale Bankmaatschappij' for their financial support. We are particularly grateful in this respect to the Dutch Minister of Education, Drs. W.J. Deetman, for his special grant, which made this publication possible.

Henk Van daele
State University of Ghent

Marc Vansteenkiste
University of Antwerp

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Part. I

Introductary papers

INTRODUCTION 12TH CESE CONGRESS

Adams, F.

Rector UIA

Ladies and Gentlemen,
Professor Mitter,

This congress of the Comparative Education Society in Europe, intends the evaluation of the impact of technology on science and particularly on education. This is an impressing important set of goals. It seems to me though that you, participants to this congress, are well prepared to make this meeting a full success. The organisers elaborated an excellent introductory document for your discussions with summaries of the communications of the participants. The participants being present here come from nearly all countries of the European community, even from our new member states Spain and Portugal; they also come from a variety of other countries in Europe, from overseas Canada and the U.S. but also from countries such as the P.R. of China, Ghana, Egypt, Bahrein, India, Iran, Malaysia and many others. This wide participation from all over the world sufficiently shows the global importance of the topics to be discussed, topics of utmost importance in this decade.

The evolution in the 18-19th century was characterised by the change from a predominantly agrarian society to an industrial society. The evolution was slow and there was ample time to adapt mentally to the development. The much more rapid evolution now - one may rightfully call it a revolution - is one from an industrial society to a society based on information. Developments for the remaining years of this century will be overwhelming characterized by the problems created in this transformation process towards the electronic information era.

Telecommunications together with the applications of ever more refined solid state electronics will dominate the economic, social and political climate to a large extent. Simultaneously, this development will give rise to hitherto unexpected possibilities for the exchange of information. Information exchange between countries which will decrease the size of the world to what Marshall Mc Luhan already in 1964 called the global village. Exchange of information between people with a drastic change of transfer media with electronic mail, networks of computers and data bases which will be retrievable from varied places, even from the living room of the home of each of us. Exchange of information also between teachers and students, with a variety of new technological possibilities for better education. The technological impact of this will be extremely important, as with the speed with which new science is generated, students will have to adapt much more quickly than ever before to the changing society. In an era when university graduates will need updates within their scientific discipline even 5 years after graduation, it becomes increasingly important for the university to rethink its mission and its organisation. The university should move away from its mission to educate the 18-25 years old, to a more complex pattern in which emphasis will also have to be placed on adult education and permanent updating of scientists and professionals. The university will also have to adapt its educational process and place emphasis more on developments of skills and on the formation of generalists instead of on knowledge and specialisms which will be outdated rapidly.

We are glad that you selected Antwerp as the meeting place for your congress. I am sure that you will be happy with the choice of the meeting place, that the local organisers did not spare efforts to make your stay here both agreeable and productive. When I wish you a scientifically productive stay in this historic city of Antwerp, I also want to express my wish that you take at least some time to visit the touristic attractions of our city, which after all was the center of trade and commerce of XVIth century Europe and which afterwards, in the XVIIth century, when ruined by the results of the religious wars, became again of such an importance with baroque art and painters as Rubens, Van Dyck and Jordaens.

Good luck with the congress.

WORD OF WELCOME ON BEHALF OF THE PRESIDENT OF THE DEPARTMENT FOR TEACHER TRAINING

Daems, Fr.

Vice-president of de Departement
for Teacher training - UIA

Dear colleagues,

I am glad to be able to welcome you here on behalf of our educational department. Let me start by excusing prof. De Corte, the chairman of our department, who was unable to be present this morning.

This congress is important for our educational department for several reasons, upon which I intend to dwell some moments, even though in congresses I do not like introductory speeches, welcome addresses and the like.
Nevertheless I would like to draw your attention to a few points that seem important to us.

First of all, there is the fact that in 1985 in academic and other circles, the term 'technology' almost automatically seems to trigger off the world of computers. This is somehow symptomatic, at least for the western world. If we go back, say some 15 or 20 years, the term 'technology' would have evoked quite different concepts in the world of educationalists. We would have thought of radio, television, movies, tape recorders, language laboratories, chemical or physics laboratories and the like. If the term 'technology' nowadays seems to trigger off the notion of computers and of a computerized society, this must be indicative of the impact that computers have in the presentday world, or at least indicative of the importance that educationalists are inclined to confer to computers in education.
I would hope that this congress will not simply equate technology and computers. The abstracts that I have read, made me confident that quite a number of participants are not willing to make such a simple equation.
Moreover, I do hope that those sessions that will be devoted to computers in education, will be critical, i.e. that they will not worship a new god called 'micro'.

In the second place, as the vicechairman of our educational department, I would like to stress the fact that our department is particularly interested in technological developments and their impact both on schooling and on teacher education. It is by no means mere fortune that work group no. 6 will be coordinated by two members of our department, prof. W. Decoo and prof. G. De Corte.

Right from the beginning of this university in 1972, our department has been paying much attention to educational technology. It is part of our teacher training curriculum, and this holds for students of all backgrounds: positive sciences, social sciences and the humanities. We have quite some equipment for our students to train. Moreover, developments in educational technology, including computer assisted learning and instruction, are integrated in several courses. To this may be added the fact that attitudes towards technology and a technological society are a topic in some of our courses.

Some moments ago I was a bit critical about computers in education. This does not refrain me from pointing to the fact that in recent years some of our department members have been spending quite some time and effort on educational software. We know that a lot of educational software that is currently available, is often of rather poor quality in terms of principles of the learning process. Faced with such a situation one might do some abstract research on the qualities of educational software. Some colleagues in our department respond in a different way. Their approach consists in developing some software themselves, thereby demonstrating in a pragmatic way the characteristics of high quality software. I am thinking for instance of software that is being developed for language courses, notably French as a foreign language and Dutch as a first language.

Finally, I would like to point out that some research has been done on the way education should be improved in order to bridge the gap between school and a society that is rapidly growing more and more technological.

I have a third, more personal, reason for being glad to have the opportunity of welcoming you.

This third reason is related to the fact that I am not a proper educationalist, but rather a mixture of a linguist and an educationalist. Quite a number of colleagues in our department are in a comparable position. They are linguists, social scientists, biologists, etc., who are particularly interested in merging their own discipline with educational science. In other words, they try to bridge the gap between school disciplines and educational sciences.

They, or rather we, believe that the quality of schooling and education cannot improve, unless new educational views are thoroughly, not just superficially, integrated in the various school disciplines and in the practice of teachers.

Therfore, I would like to express the wish that the congress participants, and more specifically the speakers, keep in mind that educational innovations are often unsuccessful because no sufficient attention has been paid to the implementation of the innovations in actual class and school practice.

But since this congress takes the comparative perspective, I am confident that we will be able to learn from each other's experiences.

Therefore I wish all of us a very good congress.

THE IMPACT OF TECHNOLOGY ON SOCIETY AND EDUCATION. INTRODUCTORY REMARKS TO A COMPARATIVE PERSPECTIVE

Mitter, W.

President CESE

Comparative educationalists have always favoured the idea that scientific knowledge should be used for the support and improvement of educational practice. It is true that the history of the effects of comparative studies on reforms at the grass-roots, i.e. in class-rooms and other educational set-ups, as well as in education systems has not yet been written. I doubt that this will be done at all in form of a complete and general analysis. There are some significant factors complicating any enterprise of such kind. In this context let me only point to two factors. On the one hand we must consider the duration of impacts, since most of them become manifest in long-term processes which are hard to assess. On the other hand most effects are of rather an indirect quality, as they produce side-effects, often undesired. This problem area affects educational science as a whole (and the other social sciences too). However, the assessment of effects to be made out in the intercultural range is dependent on the identification of all the additional intricacies which are well known to comparative educationalists.

In the light of these uncertainties limiting the access to the field of investigation, we are challenged to discuss the theme of the 12th CESE Conference, which is to be devoted to "The impact of technology on society and education". The topical relevance of this theme seems to be beyond any doubt, which may justify our choice. The growing impact of technology on education is obvious. Inquiring into the reasons for this impact we have to depart from asking about the effects of this process on the whole of society. In Europe and Northern America modern technology emerged with the Industrial Revolution two centuries ago, starting as an autodidactic undertaking and increasingly merging with modern science to a degree which, for instance, has made socialist philosophers in Eastern Europe conceive the model of "scientific and technological revolution". However, its genuine roots are much older, reaching far into European history, whereby in this context it is essentially irrelevant whether one should start one's exploration with the period of Renascence and Humanism or go further backwards, ultimately to Ancient Greece.

In any case it seems worthwhile including in our consideration Lynn White's "provocative theory", which concentrates on the thesis that it was Western Christianity "that elevated man above the rest of creation by giving him the monopoly on the spiritual world" and "thereby established a dualism of man and nature, with man clearly as master" (1). Suffice it to add J.J. Smolicz's stimulating comment that "no other civilization appears to give man quite so free a hand". He relates his comment to "the pagan religions of the classical civilizations of antiquity" - which I do not agree with in regard of Greek philosophy and science - and "the majority of the great religions of Asia". Smolicz's comment deserves to be quoted, because it provides an explanation of the historic fact that the breakthrough in science that occurred in the seventeenth century, with the Industrial Revolution as its technological and socio-economic counterpart, paved the way for a development that has brought industrialized countries on the threshold of what Daniel Bell has forecast as the "Post-Industrial Society" (2). To end up this brief excursion into history, we should keep in mind that the "anthropocentric view of the universe with nature in the service of man" (3) has seized, though to different extent, the rest of the world, and that as a consequence of what Karl Marx, as part of his theory of history, had in mind when stating that "the bourgeoisie (i.e. the European bourgeoisie) creates a world according to its own image" (4).

Education as a whole, as well as the curriculum in particular, have undergone several changes since the seventeenth and eighteenth centuries, the most significant being the overall integration of modern science at the end of the nineteenth century into the core of "general education" and, as regards the East European socialist states, its further enrichment by polytechnical education. However, the "new technologies", emerging as the recent branch of modern technology and culminating in "hightec", are about to open a new chapter in curriculum history which is characterized by revolutionising quality.

Beside curriculum development there are three further aspects of the confrontation of education with the current phase of the industrial progress which are likely to immediately tend towards its "post-industrial" successor. First, modern technology pervades all countries and religions. Secondly, in contrast to the previous phases of industrial revolution, the present confrontation challenges advanced as well as developing countries to a degree that seems to diminish those differences that have existed up to now with regard to the addressees' accessibility. Thirdly, the impacts of modern science and technology extend far beyond the world of work, seizing life styles, attitudes and expectations of adults as well as children, which, for instance, has made Neil Postman forecast "The Disappearance of Childhood" in his provocative book (5).

In an outline like this, I am trying to present here, it goes without saying that the impacts of the rapid development of modern technology affect education in an indirect way, in so far as the people concerned, first of all pupils and teachers, are involved in the changes of life styles, attitudes and expectations I have just mentioned. On the other hand this development also influences education in a direct way too, which concerns, above all, the curriculum. This direct intervention is caused by the fact that educationists not only react to requirements and proposals which are to be traced back to economic and social determinants, but are also challenged by the rapid development of science and technology as such.

Speaking of technology, with special emphasis on its combination with its attributes "modern" and "new", I have been certainly aware of the all-embracing meaning of this word which, besides its material and methodological components, includes an anthropological quality. In this radical meaning technology comprises people's inventing and applying tools, and machines, for the purpose of utilising Nature for satisfying their wants, whereby I have chosen the expression of my thoughts with particular care and "objectivity" or "neutrality".

In many oral or written utterances the usage of the word "technology", in particular in its combination with the attributes "modern" or "new", is often confined to the means and skills which are characteristic of the present stage of our industrialised civilization. It is not surprising that as a result of such a narrowed view, to give an obviously simple example, computer instruction in and outside schools is limited to the student's introduction into the directions for use and into pure by optional tasks, turning their minds only to products or outcomes, and not to devising algorithms or to exploring the logical processes carried out by the computer.

I do not want to continue these historical and conceptual considerations. This problem area will be investigated by the plenary speakers and discussed by all of you in a much more thorough way and at a much more expert level than can be done in the framework of introductory remarks. Let me, instead, call your attention again to this specific Conference CESE has invited you to. Why can Comparative Education make a contribution to the identification of a theme which has been so often discussed at many other places - not only by educationists, but also by sociologists, technologists and, not to forget, practitioners, such as educators and politicians?

Apart from the positive response to our invitation as such, demonstrated by such a large attendance of participants, the booklet which has been prepared by the organizing committee of this conference seems to be a remarkable document to support the notion of the "comparative perspective". Of course, this booklet does not indicate the full scope of papers to be presented and discussed, and you would certainly blame me, if I tried to anticipate the rapporteur's concluding analysis. I consider the booklet as a source of departure and outlook; within this limited range it is, I am repeating, worth evaluating as an exemplary collection (6). It contains 55 abstracts and announces 19 further papers whose abstracts were not available for printing. As regards the themes submitted, I do not want to allocate them to the specific topics of the six working groups. In this context this would make little sense, since the allocation of these topics to separate working groups can only fulfil the function of organizing group work and of offering some orientation to the participants. There certainly are thematic overlappings, and a good number of the papers would fit in several working groups.

The approach I have chosen instead, consists of an attempt to subject the papers to a rough classification concerning goal and range; it has led me to identifying three categories:

a) There are 19 papers dealing with theoretical models and aspects of universal range, namely the impact of technology on science and education in a global perspective as well as the inclusion of policy-making in this process at the macro-level, while the micro-level is filled with models and reports on instrumental, didactic and methodic experiments. This group of papers will certainly be useful as an incentive to drawing our attention to the cross-disciplinary dimension of our conference theme, thus reinforcing the topics to be presented by our plenary speakers.

b) 32 papers, i.e. the majority, concentrate on topics relating to one country each. Most of the authors within this group want to speak about experiences and innovations in their own countries. Comparative educationists have always emphasised the demand for such case studies forming the indispensable base of any problem approach. In particular they appreciate such studies if their grids or sequences are presented with such a stringency as to provide data and arguments for "implicit comparison" (7).

c) It is, however, the third category which paves the direct way to the comparative perspective. In the table of contents it is represented by 23 papers whose topics can be subsumed under three subcategories. 9 papers deal with Western countries, in particular member states of the European Community and the Council of Europe. In three papers the comparison comprises West and East European countries, including the Soviet Union. Six papers are focussed on educational problems in developing (or better: less developed) countries, especially in the Arab world. Finally, 5 papers can be related to an overarching "crosscultural dimension", because their authors, though coming near the model building inherent in the first category, reveal comparative ap- proaches with references to specific countries or regions of each of the "three worlds".

This evaluation could be utilised as a quasiempiric approach to the crux of our discipline which, of course, is not my concern at this moment and place. Let me, instead, quote this paragraph from Gulistan Kerawalla's paper which, in my opinion, fulfils the task of stressing the justification of this specific conference: "The disparities in the nature and paths of technological development on the industrialised and developing nations necessitate that the problems and issues which arise in education as a result of technological change are examined within each specific national context. Problems vaguely perceived as being 'common' would then reveal distinct peculiarities. By the same token, these disparities preclude the adoption, prior to systematic comparative analysis, of policy solutions from one society to another" (8).

Certainly, this statement does not contradict the universal relevance of the impact of technology on education and society. It emphasises, on the other hand, the need for mononational and crossnational or crosscultural comparisons. Otherwise the theories of universal range will not meet the specific needs of individual persons, groups or societies, and, with special reference to our conference theme, scientific knowledge will not be used for the support of educational practice.

Coming to an end, I would like to put forth some concluding remarks which immediately result from my preceding thoughts.

In the following days we are likely to be provided with rich and multivarious information on microcomputers and other "new technologies" as well as on methods of how to introduce them into educational practice in general and into classrooms in particular. Exchanging such information, with special regard to different socio-economic, cultural and political background conditions, will certainly satisfy part of our curiosity. However, we should be misled, if we forgot to include the human level in our discussions.

To illustrate this consideration, let me recall an experience of my own leading me to my professional activity as a young teacher and, further backwards, to my adolescence, when I attended the gymnasium (academic secondary school) upper stage myself. Among the "free compositions" pupils had to write as part of their maturity examinations or only as ordinary papers on the subject of 'German language and literature', there was a widespread theme favoured by examiners and individual teachers. It was titled "Technology, blessing or curse?" It is true that at that time nobody, except a few sophisticated visionaries, even dreamed of computers entering classrooms, but the objects whose impacts on society (and education) the pupils should refer to were airplanes, radios, turbines and other devices of what was subsumed under "modern technology".

Compared to that period, forty or thirty years ago, the objects of the "impacts" have expanded in number, as they have improved in quality. There has also been some change in the metaphorical approach to our theme: instead of those metaphors taken from Christian technology which, to be frank, had been secularised at that time already, social scientists of these days tend to prefer a terminology which is more worldly in itself. For instance, T. Cerdeira, in his paper prepared for this conference, forecasts "social decadence or renewal" as the dichotomous outcomes of people's options in relation to technology and educational policy (9).

The substantial problematics have, however, remained the same. It is the individual human being in his/her real existence who must be identified and respected as the addressee of any impact, that means, in our case, the impact of technology on society and education. Refuting this postulate may, for instance, lead to conceiving and using technology as a means to exploit Nature for people's disaster instead of investigating and implementing its potential functions of fostering Nature for the sake of people's survival.

Finally, we should be aware of the historically based experience that education has often been considered and practised not only for the sake of promoting human welfare and right. There is multivarious evidence that educational measures have been characterised by indifference to moral values and, moreover, misused for human goals, such as discrimination and pressure. Particularly the history of the recent past bears evidence of teachers and educators who have practised education for violence and hatred instead of being agents for democracy, peace and human dignity. Let us not forget that educated technologists have laid the ground for improving agriculture and medical care, while others constructed and used the gaschambers of Auschwitz.

Let me wish all of us a fruitful exchange of views and experiences and, moreover, a few days of open communication in the stimulating atmosphere of this University.

Notes

1. Lynn White, Machina ex Deo: Essays in the dynamism of Western culture. Cambridge (Mass.) 1968, cit. from: J.J. Smolicz, Cultural values and scientific development. In: R.E. Vente/R.S. Bhatal/R.N. Nakhooda (eds.), Cultural heritage versus technological development. Challenges to education. Singapore, 1978, p. 67.
2. Cf. Daniel Bell, Coming of postindustrial society: A venture in social forecasting. New York 1973.
3. J.J. Smolicz, Cultural values ...(vid. note 1), p. 48
4. Karl Marx/Friedrich Engels, Werke (Works). Edited by the Institut für Marxismus Leninismus beim ZK der SED. Berlin 1956 et seq., vol. 4, p. 466.
5. Neil Postman, The disappearance of childhood. New York 1982.
6. The impact of technology on society and education. A comparative perspective. 12th CESE congress 15 July 1985. Antwerp 1985.
7. Cf. Leonhard Froese, Ausgewählte Studien zur vergleichenden Erziehungswissenschaft. Positionen und Probleme (Selected Studies in Comparative Education. Positions and Problems). München 1983, p. 38. Wolfgang Mitter, "Komparative Forschung in der Erziehungswissenschaft" (Comparative research in educational science). In: International Review of Education, 22 (1976) 3, p. 324.
8. The impact of technology on society and education ... (vid. note 6), p. 119.
9. The impact of technology on society and education ... (vid. note 6), p. 127.

PERSPECTIVES OF NEW TECHNOLOGIES IN EDUCATION

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1.Introduction.

When thinking of the theme of the conference and the title of our presentation many conceptual questions arise, e.g. what is meant by new technologies or, more generally, by technology? what are the old technologies? in what respect does technology in education differ from educational technology?
Besides, at present many writers are speaking of information technology or new information technologies, instead of new technologies. In order to be able to discuss perspectives of new technologies in education we have to discuss some conceptual aspects first.
First of all, we will use New Technologies (abbr. NT) in the same meaning as others who are speaking of information technology or new information technologies. When analysing descriptions (or definitions) of technology or new (information) technologies (e.g. Galbraith, 1967, US Office of Technology Assessment (OTA), 1982, and UNESCO, 1983) it can be concluded that NT has to do with storing, retrieving and processing data for the purpose of gaining information to attain certain ends (e.g. acquisition of knowledge, control of process, decision making). However, it is also clear that NT as a concept has no straightforward meaning, because at least four different aspects can be distinguished, viz. (a) the purposeful application of knowledge, (b) the disciplinary and technical knowledge itself, (c) the machines and systems (products) produced by exploiting the knowledge, while UNESCO is using a definition in which is also reffered to (d) the associated social, economic and cultural matters. The fourth aspect has little to do with the description of NT, but is referring to its effects in our society, intended and unintended, desirable and undesirable (Plomp and Van de Wolde, 1985). In principle we will not exclude any of the four aspects.
However, in many publications NT is conceived just as products and (or) disciplinary and technical knowledge. We will therefore elaborate these two meanings a little further.
At present there is a great variety of products which together

form the NT. OTA (1982) gives the following enumeration: computers, cable systems (some with two-way communication), satellite communication, digital telephone networks, broadcast technologies, storage technology (silicon chips, floppy disks and hard disks), video technology and video disks and information services (e.g. videotex systems, information networks, electronic conferencing). All these NT products could be developed out of three advanced technologies (in its second meaning, viz. disciplinary and technical knowledge): computer technology, micro- electronics and telecommunication. Computer technology provides us with an immensely powerful and quickly working information processing machine. Microelectronics, as a result of the ongoing miniaturisation in electronics, allows us to mass-produce powerful data microprocessors (the 'brains' of NT products) at very low costs. Telecommunications give the means to communicate informa- tion over distances, accurately and speedily. In summary, the new technologies provide us with immense possiblities for storing, retrieving and processing data, which can be utilized not only in business and industry, but also in education.

Before discussing the perspectives of new technologies (NT) in education, we will first characterise changes in our society which (partly) determine desired or necessary changes in education (section 2). Because new technologies refers to the existence of old technologies, we will discuss some developments of the old technologies and the lessons learned from this (section 3). Then, in section 4, the consequences of the new technologies are discussed on three levels, viz.the general goals of education (4.1), the curriculum and course level (4.2) and the teaching and learning aids (4.3). In the final section we will discuss the consequences for further research, in an international context.

2.The changing society.

The above mentioned information processing functions of the NT are so intensively used in business, industry and the service sector, that several authors, e.g. Toffler (1980), Naisbitt (1980) and Häfner (1981, 1982) have argued (in different styles), that our society is changing from an industrial society to an information society, this means a society in which most of the people work with information rather than produce goods, and in which information has become an important commercial product. Characteristic for the changes in our society is that many human activities, manual as well as cognitive, are or will be taken over by information technology systems. Some examples from business

and industry, which illustrate this proposition, are: computer aided manufacturing (robots), computer based process control, computer aided design, electronic mail and electronic banking.
Häfner (1981) rightly concludes that the informational environment in the eighties will cause a new balance of storage, retrieving and processing data between human beings and machines.
Besides these (and other) examples, illustrating that in business and industry jobs are vanishing and (presumably) fewer new jobs are created, the influence of NT is already manifest in existing jobs and will become more so. Just two examples as illustrations: the use of wordprocessors in the work of secretaries and the use of interactive videosystems by sales people to show specific features of new products (e.g. already applied on a large scale by the automobile industries in the USA).
We may conclude that mainly because of economic arguments such as competition, cost-effectiveness, and pressure of the computer and communication industry, business and industry are demonstrating a 'natural affection' towards NT and its applications.

To complete this picture, we also have to take into consideration the homes. Things usually happen in the households quite naturally. This is also true with respect to information technology as we have experienced in the last decades: television with distance operation, automatic washing machines, a variety of computer games and, more recently, microcomputers have found their way into our homes without problems. In this perspective it is not surprising that toy manufacturers in the USA are the largest buyers of silicon chips (Hawkridge, 1983).
Given the natural development of these processes we may expect further development in the homes in the near future, such as individualised use of NT (e.g. paid-TV, interactive access to databanks) that will be available via cable, video, recorder and satellites, or interactive videotex-systems, combining the TV-set, the home-computers, the central computers and centralised data storage via telephone lines. All these developments will also greatly enlarge the possibilities of taking part in educational activities in a variety of individualised settings outside the traditional schools.

The role of education

What will be or should be the role of education in this era of information technology?
Schools, as the places where traditionally most of education takes place, are less open systems than the world of business and

industry or the home. A consequence of this fact is that developments in the schools take place less naturally or at least at a much slower pace. This is to a large extent due to the organisational and budgettary structure, or our educational systems lack the mechanisms for an alert and quick response to the developments which are taking place in the world outside the schools. Yet, the schools, where students have to be prepared for their future role in our society, should react to the developments of new technologies in our society. The changing balance between human and automatic information processing, examples of which have been described earlier, is asking for a new approach to and a new plan for education. The fact that many manual and cognitive skills are being taken over by machines will - if education does not change - result in a discrepancy between the goals for which students are educated and the skills which our society demands of school graduates. In this context Häfner (1981, 1983) speaks of a crisis in education.

What should be done to overcome this potential crisis in education? How is it possible for education to continue to fulfil its tasks in the future, viz. to prepare people for their future functioning in our society? One thing is clear: neglecting NT will not be allowed. It is not possible either to address the question whether or not the computer, or NT generally, should be introduced in education. It is no longer an issue, because computers are already used in many schools. The main question to be answered now is: How should schools react to their changing information environment? The possible answers to this question will depend on how schools, or more generally our educational systems, including national, regional and local governments, conceive their mission in our society and on how they believe they have to respond to developments in our rapidly changing society.

3. The old technologies-educational technology

Speaking of new technologies suggests that there are also 'old' technologies. Before discussing the meaning and consequences of NT for education, we will first analyse what can be conceived as old technologies and what lessons can be learned from our experiences with the application of old technologies in education.
The use of technological products for educational purposes is probably as old as mankind: we know e.g. of clay-tablets, handwritings, printed books and (wall)pictures. All of these were applied for educational purposes. Technological products of the

fifties and sixties are e.g. film-strips and slides, motion pictures, programmed instructions, television and also the computer (at that time main frames) (see e.g. Gerlach and Ely, 1971 and Brown, Lewis and Harcleroad, 1973). When applied in education the words educational technologies are commonly used. From the development of educational technology much can be learned which is useful when trying to shape responsible applications and uses of NT in education.

Several authors have analysed the developments with respect to educational technology (e.g. AECT, 1977; Saettler, 1978; Davies, 1978; Romiszowski, 1981; and Plomp, 1982). From these analyses three types of descriptions, and therefore of applications, of educational technology are emerging. Educational technology one is in essence a 'product' approach, viz. all sorts of materials, machines and hardware (esp. audiovisual products like television, projectors, recorders, language laboratories, etc.) as technical aids in teaching: aids to presentation, to assessment, to demonstrations, to the solution of logistic problems, etc. The presupposition behind this approach is that the quality of education will improve when the newest equipment is used in the educational process (this thinking was analogous to manufacturing conceptions in industry). Komoski (1984) points to the fact that schools that purchase and teachers who use such materials have delegated most of the important curriculum and instructional design decisions to the material's developer (which fact is frequently not recognised by educators and administrators). When the material selection process in the school has failed to produce an adequate fit between a product, a teacher and a learner, instructional design decisions made by the material's developer are frequently disagreed with or ignored by the teacher (Komoski, 1984, p. 11). If we add to this, that for many of these 'old' technologies we hold that teachers were insufficiently trained to use them appropriately, it is not surprising that much of this type of educational technology passed out of the schools and the classrooms.

Educational technology two refers to the knowledge about the process or techniques for designing software or instructional materials or programmes (e.g. programmed instruction). This technique is characterized by a stepwise procedure: define objectives, decide method, develop resources, test, evaluate and implement (Davies, 1978). An objection to this concept of educational technology is that is too easily and selfevidently suggested that a problem in education should be conceived as an instructional problem which can be solved by just applying this type of educational technology. But both educational technology concepts do have their limitations. They refer only to parts of the teaching and/or learning process: educational technology one to new teaching aids with the risk of not considering the teaching/ learning process as a whole; educational technology two to knowledge about the instructional design process with the risk that too easily systematically designed instruction is chosen as the solution without considering other alternatives. Stated in other words: central in educational technology one and two is the technology (i.e. the product or the design process) as the selfevident solution to educational problems and not the educational problem in its context for which a solution is needed.

A real breakthrough in educational technological thinking was the growing understanding in the sixties that the real improvements in education cannot be attained by merely considering isolated parts of the educational process, viz. those parts which can be easily approached with fashionable machines or modes of instruction. Inspired by developments in other disciplines (e.g. engineering, business administration), a holistic approach developed gradually: a problem must not be isolated from its context, but has to be analysed in this context and approached with an open eye for the many factors which determine this context and can play a role in the solution. This process can be characterized as a development from closed systems thinking to open systems thinking. This problem centred educational technology three can be characterised as a systems approach. It is important to point to the fact that the other concepts of educational technology are essential parts of the systems approach of educational technology because they can serve as valuable means in attaining certain goals or objectives.

From these developments with respect to the old technologies, Plomp and Van de Wolde (1985) point to some lessons that can be learned when we consider the perspectives of NT in education. In doing this we are referring to the introductory section where we point to four aspects in the definition of NT.

First, NT has to be conceived as more than just a collection of modern technological products which have to be used in education while their usefulness are taken for granted. This is a too limited concept, because too easily, the means may become the central focus of attention without considering the ends for which the NT products are meant to be instrumental (see our earlier reference to Komoski, 1984).

For the same reasons NT just as a body of disciplinary and technological knowledge, which can be introduced in education e.g. by teaching courses in informatics, is a too limited concept when considering the potentials of NT in education. From the developments of the 'old' technologies it can be learned that conceiving NT in either one or both meanings carries the risk

that NT in education deteriorates into dropping technology in the schools either as products or as new courses without taking into account the needs, the problems and the limitations of these schools. This lesson from the history of educational technology may seem trivial, but is not a trivial one at all. We all know stories of authorities (local, regional or national) or parent-teacher associations which were putting pressure on the schools to introduce computers, while they were not prepared at all for this type of innovation or did not even have any ideas about what to do with it. At the other side, much can be learned about the potentials of NT in education when, being aware of the limitation of the context, a careful study will be made of NT as a product or as a discipline in education.
The impact of NT in education will be stronger than that of the old technologies. The arguments for this position stem not only from essential differences between the old and the new technological products, but also from the influence of NT in our society and the consequences thereof for the goals of our educational systems.

4. New Technologies in Education

In an OECD study, when analyzing the forces underlying the technological demands for and on education, the following arguments are put forward for introducing NT in education (OECD, 1984):

1. The needs of the economy: to produce specialised manpower.
2. The need to prepare the young to be functional in a society permeated with NT, by giving them also a basic education in NT.
3. The improvement of the teaching/learning process: NT adds new powerful tools to education, by which its quality and effectiveness can be improved, especially low achievers and gifted may profit from this advantage.

The needs of the economy refer to the role of NT in vocational education. Although this application of NT is very important we will not discuss vocational education separately in this paper (see for a discussion e.g. Plomp, 1985).

The second need deals with the general preparation of all pupils to become functional and responsive citizens in our society, while the third need refers to the use of NT, at present especially computers, as an aid in teaching and learning. Considering the last two needs we may conclude that NT will influence education on three levels; viz. a) the general goals of education, b) the curriculum and the courses taught in schools and c) teaching and learning aids. We will discuss those three levels in the following sections. In doing this we will rely heavily upon the work of Van de Wolde and Plomp (Van de Wolde, 1984, and Plomp and Van de Wolde, 1985).

4.1. New Technologies and the General Goals of Education

Though new technologies and their application in education has only recently gained public attention and a widespread use in the schools, often its impact on the educational systems has partly been recognised. Favourable aspects seem to be those the present system can quite easily deal with, e.g. the use of drill and practice programmes.

However, it should be noticed that the impact of NT on the educational system will be radical. Education has to reconcile itself with the new technologies. This implies that school curricula have to be attuned to living in the information society and to the development of qualities in which the machine (c.q. computer) can be no competitor of human beings (Van de Wolde, 1984). Many topics and subject matter, as they are taught today, with an emphasis on memorisation or reproduction of facts, may no longer be of relevance in the information society. As Simon (1971) states, the meaning of the verb to know is changing from what you have in your head to what you are able to access. Or stated in other words: the disconnection of knowledge accumulation and knowledge application, already set in with the introduction of printing, seems to become definite by now. For this new type of knowing not only analytical, but above all creative and synthesising skills are needed. According to Hunter (1982), handwriting, spelling, arithmetic computation and memorisation of facts are examples of basic subjects that may be deemphasized in favour of problem solving, information handling, experimentation and greater social interaction. Without drawing the same conclusions immediately, one may say that our schools should concentrate more than till now on the development of productive (instead of reproductive) skills, i.e. higher order skills, which enable people to generate and evaluate answers adequately by themselves, when new circumstances arise. Such 'metaskills' can be developed by learning to learn and learning to solve problems. This implies that in our curricula accents cannot be laid exclusively on content, but in a greater degree also on learning processes (Van de Wolde, 1984, Plomp and Van de Wolde, 1985).

A second goal which should be pursued in our education (and which is related to the first one) is the development of information handling skills, i.e. children have to learn to deal purposefully with data (information). For, to be able to work with computers (or, more generally, with new technology systems) one needs to know more than just to operate these machines.
Computers will be used for a purpose, e.g. the acquisition of knowledge (exploration, testing hypotheses, learning) or the controlling of processes or the preparation of decision making processes. For these purposes new technologies are instruments in a process of information handling and data processing. The Dutch Advisory Committee for Education and Information Technology has pointed to the complementary character of computer science or informatics and information science; see appendix and AEIT (1984).

It should be noticed that this new technology will not only affect the goals and content of teaching and learning processes in schools, and the forms these can take, but it will also create important opportunities for these processes to take place out of school and beyond school age. Unlike other kinds of technology NT fosters demassification and decentralisation, making it possible to use an interactive instructional approach tailored to the wishes and potentialities of the individual. The opportunities to receive information or tuition outside the formal educational system are greatly expanded. The traditional school has already lost its monopoly as a delivery system of knowledge. The school of the future also has to take this development in account.

As a fourth point, professions will change, nowadays and in the future, as a concequence of technological developments. We may expect that a majority of professional workers will have to learn permanently. In many countries the so-called 'recurrent education' is already discussed largely. It is a new educational goal to prepare people for lifelong learning.

A final aspect which has to do with the general goals of education is the loss-of-a-job perspective for many young people. A consequence of this is a decrease of motivation for attending school. We might state it more positively: the information society is also becoming a recreation society, which will have consequences for our schools: how can we motivate children for school and how can we prepare them for a society with plenty of time.

As we have seen, the development of new technologies may have great consequences for the general goals, and therefore for the content and the organizational structure, of our schools. Fortunately, the new technologies also offer us some powerful tools which can be instrumental in attaining and realizing the necessary changes. Some of them will be discussed briefly in the next two subparagraphs.

4.2. Consequences on the Course Level

What does the shift in emphasis in educational goals mean for the level of the school's curriculum and courses. It is clear that many existing disciplines or subject matter domains will remain in their place in the curriculum of the school of the future. An important question is how the content and the (didactical as well as organizational) structure of existing courses can or have to change so that students really learn to learn and to solve problems and to master information handling skills. We believe that new technologies can be instrumental in this.

Another question is whether new subject matter, or even new courses, should be taught as part of general education. Until now most attention has been paid to the question of familiarizing all citizens with the technology itself, especially with computers. In the literature a great number of labels can be found referring to introductory forms of computer education, e.g. computer awareness, computer appreciation, computer initiation, computer familiarization, computer literacy, etc.. There is no consensus as to the meaning of these terms, though they are often used to indicate distinct levels of proficiency. While some authors conceive computer literacy as a continuum ranging from computer awareness to computer fluency (e.g. L. Braun quoted by Aiken & Moshell, 1982), others associate this term with some minimal level of understanding computers and their impact upon society. The Dutch name 'burgerinformatica' (literally translated citizen's informatics) is used in this way, to indicate the level of understanding required for all citizens to enable full participation in the information society.

Computer literacy education is supposed to serve several goals. Some of these goals may be considered as specific to the computing domain, while others are more general in nature, since they imply the development of skills that are supposed to be applicable or transferable to many different domains.

Among the specific goals the following are often mentioned (Plomp and Van de Wolde, 1985):

a) Development of proficiency in using computers.
b) Development of understanding of computer applications, and their implications at both social and individual level.

c) Elimination of phobies and anxieties related to computers.

d) Elimination of 'computer mystique' and development of a deeper understanding of the capabilities and limitations of computers.
Besides these specific goals, computer literacy is also often connected with some general educational goals mentioned before, viz.:

e) Development of skills in problem solving.

f) Development of information handling skills.

Differences between existing computer literacy courses mainly reflect differences in the weighting of these goals. Van de Wolde (1984) evaluated the literature on computer literacy courses which have been developed over the last 10 years and presents the following categories:

- computer orientation: e.g. functioning of the computer, elementary programming,
- application orientation: dealing with application environments rather than programming environments,
- algorithmics orientation: mainly stuctured around problem solving strategies and principles of algorithm,
- information orientation: micro-electronics based new technologies are integrated with older forms of technology and the computer is considered as one (although a very powerful one!) of the available means to produce, store, retrieve, use or communicate information (see also appendix).

Seen from a historical perspective, computer literacy curricula have shown a remarkable overall shift away from 'teaching computing' to 'teaching information handling and problem solving'. This development typically resembles the one of educational technology in general, discussed above. Computer use is no longer viewed as a goal in itself, but is introduced as a powerful means to fulfil information needs, taking into account its consequences for the 'wider system' (Plomp and Van de Wolde, 1985).

4.3. New Technologies Aiding Learning and Instruction

NT not only confronts the educational system with an urgent need to revise its goals, content and processes, it also provides this system with powerful tools to meet those ends and to improve its output. The feeling that learning and teaching are processes par excellence to profit from the unique potentialities of computers in processing, carrying, and presenting information, has been shared by many developers and researchers ever since these machines were put on the market. Research has demonstrated that computers provide a valuable and sometimes even irreplaceable addition to the repertoire of educational designers and teachers. There are three modes in which the computer can be used as an aid in learning and instruction: tutor, tool, tutee (Taylor, 1980). To function as a tutor in some subject, the computer must be programed; the student is then tutored by the computer while executing the programme. To function as a tool the computer only needs to have some useful capability programed into it (e.g. word processing, statistical and other calculation packages, data bases, spread sheet). Students can then use the computer to help them in a variety of subjects and situations. To use the computer as tutee is to tutor the computer. In this mode it is necessary that the student or the teacher doing the tutoring of the computer must learn to talk to the computer in a language it understands (Taylor, p. 3,4.). A wellknown example is the turtle geometry (developed by Papert, 1980) in which students can interact with the computer in the language LOGO.

From several meta-analyses performed by Kulik et al (a.o. 1981, 1983) on the results of a great number of studies regarding the outcomes of 'computer based instruction' it becomes clear that thus far its major contribution concerns the efficiency of instruction: one needs significantly less time to reach a certain level of mastery. The effect on the learning outcomes per se seems to be far less pronounced. On the other hand, interesting effects are reported in the attitudinal domain: when computers are used, learners are slightly more positive about the content and method of instruction, and show a much more positive attitude towards computers.

Plomp and Van de Wolde (1985) make the following remarks in connection with these meta-analyses: it doesn't seem appropriate to treat all kinds of educational computer use as a single category, as Kulik et al. did. Using a computer in tutor mode e.g. to give feedback in a drill-and-practice situation is not to be com pared with an application in a tutee mode, e.g. computer programing to teach problem solving. These approaches may reflect basically different didactical viewpoints, stressing either receptive or discovery teaching strategies. Whether one will be succesful in evoking a particular learning outcome depends on the whole pedagogical environment of which the computer system is only one element. If a teacher doesn't know how to induce and guide discovery processes in his pupils when there are no computers around, it is not very likely that he will be able to do so merely by introducing e.g. LOGO in his lessons. He will probably end up teaching LOGO just as he would teach BASIC, successively introducing new features of the language, whether or not they may have any significance to his pupils by that time. In more traditional educational contexts it will be easier to implement tutor mode applications that match expositive teaching strategies.

Therefore, it is important that also attention will be paid to the role of the teacher, as the innovation must ultimately be realized via them. Olson (1984) points to some important aspects. As a consequence of NT the relationship between teacher and students/pupils will change: pupils will learn more independent from the teacher. Do teachers accept this new relationship? Are they capable of 'playing' their new role? Besides this, microcomputers are not yet domesticated sufficiently, i.e. the structure of courseware is such that it is very difficult for teachers to help their pupils when they have problems during their computer assisted learning. We earlier pointed to the problem of the lack of fit in instructional design decisions between teachers and material developers (section 3). To our opinion, Olson is rightly stating the question whether the microcomputer will become teacher's pet or his 'Trojan's horse'.

5. The Role of International Research

In the preceding sections we discussed the effects of New Technologies on society and the content, process and organization of education. Our conclusion can be worded as follows: as a consequence of NT education has to change and with the appropriate application of NT it is, in principle, possible to change education in the desired direction. It is however difficult to predict what will actually happen, as was the case with earlier innovations. Scriven (1974) argues that the most important effects of many innovations are the unintended outcomes, or side effects. Maybe predictions for the near future are possible, as Lias (1982) concludes that initial applications for inventions mimic established uses of whatever they are replacing before becoming innovative.

When we look at the current situation in most countries, we can see that education is not waiting until all questions are answered. Many schools bought computers, with or without financial help from agencies outside the school. Throughout the world there are large differences between countries in the kind of developments, varying from plans controlled by central governments to just grassroot developments. This means that not only at the national level but also at regional and local levels many different decisions are made, which are the outcome of 'political' discussions in which many social pressure groups are involved. As a consequence of

this there is a lot of natural variation within and between countries from which we can learn by conducting research. It will increase our understanding of which goals are pursued, what approaches are working, what changes can be realized, etc.
In order to have maximal profit from this research it should be standardized with respect to the design and procedures. There is a number of organizations, e.g. UNESCO, OECD, IEA* who are already conducting or planning international projects. The UNESCO and OECD studies are aimed at increasing our understanding by gathering information about national policies and by performing case studies. The IEA study (in the planning of which we are involved) has a different approach and is intended to gather empirical data on country-, school-, teacher- and student level. Although this study is still in its planning stage, the aims and designs can already be summarized as follows: The overall aim of the IEA computers in Education Study is to contribute to building a knowledge base from which answers to questions about what and how to use computers in education can be sought.
Education policy makers, curriculum and courseware developers, administrators and teachers acknowledge the existence of computers, but are often unclear as to how computers can or should be used in education. The fact that the study is multinational in nature, covering a range of countries which are in various stages of development with regard to the introduction of computers in education, should be invaluable in helping countries to see the range of alternative approaches that are available as well as the likely effects of various policies and practices. The study will therefore be of considerable interest to countries in all stages of introducing computers into education.

The study is conceived as a two stage investigation. The first stage, approximately three years in duration, is aimed at gathering information from a representative sample of schools at the primary, lower secondary and upper secondary levels in the participating countries with regard to the current state of computers in education. It is primarily descriptive in nature, focussing on how computers are currently being used in new and existing schoolsubjects, the extent of availability of computers in schools, the nature of instruction about computers, and estimates of the effects that the computers are having on students, the curriculum and the school as an institution, as well as other factors influencing the use of computers in schools. Data will be collected via National Case Studies, School Questionnaires and Teacher Questionnaires (as an international option). The

*IEA = International Association for the Evaluation of Educational Achievement instruments will not only cover background data, present usage of computers, and views and opinions of those involved in this innovation, but also plans for the future.

The results of this study will not only be of considerable value to policy makers, educators and curriculum and software developers, but will also be conditional for the planning of the second stage of the study.

The second stage of the study will have several purposes.
First, it will provide a replication of stage 1 resulting in presenting an evolution of progress on a number of variables. Second, this stage will allow for a verification of the plans of schools in Stage 1. The degree of implementation of these plans will be revealed on variables, such as changes in needs and implementation of plans. The main second stage survey, however, will be relational in nature in that it will seek to determine the relationships between the variables of interest at the levels of planned and implemented curriculum and students' outcomes. This means that data will be gathered from students, regular class teachers, specialist teachers in computers (if there are any in the school) and school principals. The present plan calls for the survey to be conducted at one grade level at each of the following levels: primary, lower secundary and upper secondary education.
An international Centre will be established to coordinate the execution of the study by National Centres in the participating countries. Each National Centre should be assisted by a committee of national specialsits in the field of New Information Technologies in education. It is hoped to use data communication networks to link National Centres with the International Centre and with each other. We hope that this and other international studies like this, or on a smaller scale, maybe using other methodologies, will be conducted in the next ten years, so that our understanding of the innovative process of introducing NT in education will grow.

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Appendix

Information Science vs. Computer Science

This appendix is based on a report which the Advisory Committee for Education and Information Technology (AEIT) presented to the Dutch Minister of Education and Science, March 1984 (AEIT, 1984).

A characteristic of the so-called 'information society' is the presence of large numbers of data, which can easily be made available to individuals via NT-equipment. However, the availability of data does not imply automatically that one has information at one's disposal. The drawing of information from data (or messages) is a goal-oriented activity. There is a fundamental difference between data or messages at one hand and information at the other.

The difference can be learned from the description of these terms.

- 'data' = facts, from which one can draw conclusions which may lead to the solution of a problem (e.g. the inflation rate in FRG in 1983 was x%);
- 'message' = an objectified communication or text, physically recorded, e.g. text in a newspaper or on a tape (e.g. the Ministers noticed that inflation of x% is too high and that the policy of the government needed to be changed);
- 'information' = the meaning or interpretation which the receiver of data or message(s) attaches to them (e.g.the interpretation which the receiver of the message about the x% inflation attaches to it).

From what precedes it may be clear that there is no direct causal relation between the computer as professor, manipulator and retriever of data on the one hand and information as the meaning or interpretation which one may attach to the available data on the other. One can speak of an instrumental relationship between the computer and information, i.e. with the help of a computer one can derive information from data and messages (see figure).

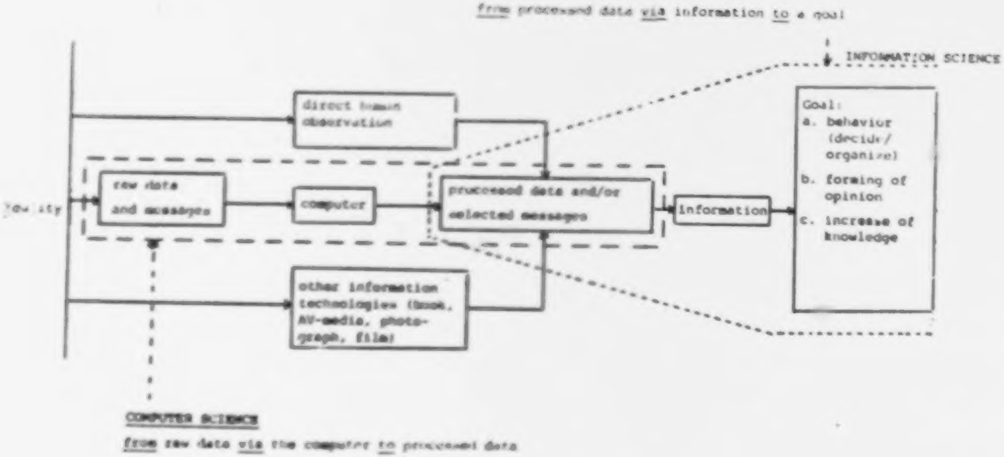
from processed data via information to a goal
INFORMATION SCIENCE
reality
direct human observation
raw data and messages
computer
processed data and/or selected messages
information
Goal:
a. behavior (decide/ organize)
b. forming of opinion
c. increase of knowledge
other information technologies (book, AV-media, photograph, film)
COMPUTER SCIENCE
from raw data via the computer to processed data

Fig. 1: The relationship between information science and computer science (from AEIT, 1984b)

LES NOUVELLES TECHNOLOGIES D'INFORMATION ET LE CHANGEMENT SOCIALE.

G. Neave

European Cultural Foundation

Introduction

Monsieur le président, chers collègues.

Votre invitation à venir parler du changement social et des nouvelles techniques me flatte et me remplit d'horreur à la fois. C'est une tâche flatteuse dans la mesure où je ne puis justifier d'aucune expérience ici, bien que l'on puisse arguer que 8 mois passés dans les environs de Menlo Park et de Silicon Valley devraient, ne serait-ce que par osmose, donner un aperçu de ce qui se passe dans ce domaine. Je me permets d'espérer qu'il en sera ainsi!
Néanmoins, c'est aussi une tâche redoutable, et ce pour deux raisons: tout d'abord, les études réalisées sur les nouvelles technologies de l'information n'offrent pas une analyse basée sur les sciences exactes de la rétrospection. Ensuite, les évaluations d'ordre sociologique sont bien moins nombreuses que les extrapolations qui font appel à l'imagination parfois créatrice.

Des tentatives d'évaluer les réactions du public vis à vis des nouvelles technologies ont été réalisées notamment à l'Université Libre de Bruxelles. (Alain Eraly, The Belgian attitudes towards new technologies, Bruxelles, Centre de Sociologie du Travail, 1984, (mimeo)) Cette étude a révélé une ambivalence aussi insondable que l'ignorance de ce qui constituent les NTI.

En l'absence de données rogoureuses, la conjecture et le spéculation fleurissent, bien évidemment. L'éducation ne fait pas exception. (W. Norton Grubb, "The Bandwaggon once more: vocational preparation for high tech occupations", Harvard educational review, vol. 45, no. 4, november, 1984, pp. 439-441) Nous sommes tous aussi consicients des revendications massives souvent faites en son nom, revendications qui promettent de changer la façe de la terre, la salle de classe, le bureau et le jardin d'enfants en insérant les NTI dans les systèmes d'enseignements.

Les promesses apportées par les NTI ont opéré un changement profond dans la perception que l'enseignement a de lui-même et par la même occasion, de la perception qu'en ont les gouvernements. Ces trois dernières années, l'enseignement semble avoir émergé du "cycle dépressif" dans lequel il était plongé au milieu des années soixante-dix. On ne considère plus aujourd'hui que l'éducation est incapable d'atteindre les objectifs sociaux qui lui ont été attribués - thème exploité de manière répétitive et tendencieuse il y a une disaine d'années. Tout au contraire, nous semblons maintenant engagés dans une phase d'optimisme maniaque qui n'est probablement égalée que par celles des Golden Sixties. Il est certain, qu'une des conséquences des NTI et non des moindres est le rétablissement de la position centrale de l'éducation auprès des gouvenements qui, eux, ne demandent que de presser le pas vers la nouvelle Jérusalem électronique. Mais au risque de lancer la pomme de discorde dans cette harmonieuse assemblée, j'aimerais suggérer que nous soyons un peu plus prudents dans nos revendications si nous voulons éviter, à un stade ultérieur, d'autres crises de confiance du public et des récriminations peu édifiantes.

Arrière-plan

Il existe un certain nombre de difficultés méthodologiques liées à l'examen des nouvelles technologies et du changement social. L'une d'entre elles, et non des moindres, est constituée par le problème de la distinction entre les changements directement attribuables aux NTI et ceux qui existent déjà dans la société et dans lesquels les NTI elles-mêmes s'inscrivent. En effet, les NTI ne sont qu'un des éléments ou l'une des dimensions de la conjoncture actuelle. Pris conjointement, celle-ci influe sur le contexte social et économique au sein duquel les NTI ont vu le jour. Bien sûr, les NTI peuvent amplifier certains de ces éléments. Mais d'autres font partie des autres aspects de la conjoncture générale.

Je pense ici à quatre facteurs: le chômage structurel, la crise de l'Etat providence, le déplacement économique et géopolitique et en quatrième lieu, l'internationalisation du processus de production.

Le chômage structurel

L'un des facteurs principaux qui affecte la manière dont les NTI sont perçues par le public est la montée du chômage structurel. Il existe un certain nombre de théories qui cherchent à donner une explication à ce phénomène. Michel Richonnier dans son livre Les Métamorphoses de l'Europe y voit le retour du balancier dans le cycle de Kondratief, cycle qui couvre à peu près 25 ans. (Michel Richonnier, Les Métamorphoses de l'Europe, Paris, 1985, Flammarion). Le retour du balancier dans ce cycle a, dit-il, débuté en 1973. D'autres, s'appuyant sur une perspective plus pragmatique, voient le chômage structurel comme constituant un aspect du processus de transition entre les occupations et les modèles économiques antérieurs et l'instauration d'une société basée sur la technologie de pointe.

Ce facteur a considérablement influencé la teneur des débats sur la possibilité de créer des emplois par les NTI's et aussi sur leur réception sociale. Il semble qu'il existe un profond désaccord sur le fait que les emplois perdus par la restructuration industrielle puissent être remplacés grâce à une formation continue dans la technologie de pointe. Des analyses faites dans le contexte américain soutiennent que le taux de croissance d'emplois créés dans le domain des technologies de pointe d'ici 1995, quoique relativement élevé, est limité en chiffres absolus. Par contre, la croissance authentique se manifeste dans des occupations qui ne nécessitent pas une formation particulière - par exemple, les concièrges, les caissiers, les employés des bureaux et des magasins (Norton Grubb, op.cit., p.439).

Quant aux attitudes du public vis à vis des NTI, elles semblent pour une bonne part, être influencées par la situation de l'industrie locale. La crainte de voir augmenter le chômage suite à l'introduction des NTI est plus marquée dans les régions d'industrie lourde. Tout au contraire, dans les régions comme la Flandre où la croissance industrielle repose partiellement sur l'utilisation de la technologie de pointe, les inquiétudes du public semblent être moindres (Eraly, op.cit.,p.12).

La crise de l'Etat providence

Le second facteur qui influence sans doute la stratégie gouvernementale vis à vis des NTI, est moins évident mais non moins pertinent. Il s'agit de ce phénomène connu sous la rubrique de la "crise de l'Etat providence" et qui porte principalement sur le fonctionnement des systèmes de sécurité sociale. Il existe de nombreux aspects à cette crise - par exemple, la croissance de la population non active, suite à une longévité accrue, à un chômage qui augmente et à la prolongation de la scolarité, phénomènes qui font augmenter la part du budget gouvernemental consacrée aux dépenses sociales.

Compte tenu de cela, il est de l'intérêt des gouvernements d'accélerer la mise en oeuvre des NTI comme moyen de maintenir la productivité et de diminuer les coûts unitaires dans le secteur secondaire. De cette façon, le revenu national peut être préservé malgré une augmentation persistante de la population au chômage.

Changements géopolitiques

Le troisième facteur prend la forme d'un déplacement géopolitique dont, pour bien des gens, les NTI sont symboliques. Peu importe si la révolution technologique constitue la troisième ou la quatrième phase dans l'histoire du développement industriel et économique. Ce dont il faut prendre conscience, c'est le fait que le noyau de cette révolution industrielle est aux Etats Unis et au Japon. Et ceci à son tour recouvre un phénomène plus vaste, c'est à dire la montée des nations nouvellement industrialisées sur le pourtour du Pacifique. Ce que seront les conséquences de ce dernier phénomène sur les rapports commerciaux et sur l'économie des pays européens, reste un domaine de spéculation dans lequel je ne me hasarderai point. Mais, il est manifeste que l'année 1980 a constitué un tournant. Cette année-là le volume d'échanges commerciaux entre les Etats Unis et les pays du pourtour du Pacifique a dépassé celui des échanges avec l'Occident européen.

Ce déplacement géopolitique a des conséquences directes sur la perspective stratégique des gouvernements européens, et sur la célérité avec laquelle les gouvernements passaient à l'action dans la formation d'une politique NTI. Les efforts ainsi réalisés peuvent être considérés comme une action d'arrière-garde, déstinée à protéger le marché intérieur et donc de prévenir, si possible, la perte de nouveaux emplois. Placés dans une perspective historique, ces évènements prennent alors une importance plus grande. En effet, nous assistons au déclin de ce que l'historien français, Jacques Godechot appelait "la révolution de l'Atlantique Nord - ce bouleversement à double dimension constituée par le changement politique qui a vu le jour dans les révolutions françaises et américaines d'une part et par la révolution industrielle britannique de l'autre. Si les NTI sont des forces qui vont façonner nos vies quotidiennes, force nous est de reconnaître que le soulèvement auquel nous assistons ou par lequel nous croyons être en train de passer est une réponse à des initiatives prises ailleurs qu'en Europe.

La fragmentation des processus de production

Le quatrième facteur d'influence est la fragmentation et l'internationalisation de la procédure de production. Ceci n'a rien de nouveau. L'origine de ces phénomènes remonte à la formation de cartels industriels internationaux à la fin du siècle dernier. Mais la croissance des multinationales pendant la période qui a suivi la deuxième guerre mondiale, ainsi que l'évolution des communications de masse dont les NTI font partie ont raffermi cette tendance. La dispersion d'un processus de manufacture à travers différents pays, son contrôle et sa gestion effectués ailleurs ne constituent pas non plus de nouveaux facteurs. Dans ce contexte général, la capacité des NTI est d'augmenter à la fois, la part du contrôle financier centralisé et la fragmentation, d'aucuns diraient la déqualification et la dénatalisation du processus de production.

Je mentionne ces quatre points pour souligner que les NTI sont des constituants d'un ensemble de changements dont la portée va au-delà des retombées directes des NTI. Pris globalement, ce changement comprendrait des transformations dans les modèles d'investissement, la montée des nations nouvellement industrialisées et le développement des processus interdépendants de contrôle et de production qui ceinturent le monde.

Continuité et changement

Pour emprunter une phrase au prédécesseur de M.Mitterrand, les nouvelles technologies d'information représentent à la fois la continuité et le changement, ainsi que la continuité dans le changement. Quant à la continuité, il est possible de distinguer dans le domaine de l'éducation un cycle de réforme qui semble évoluer sur une périodicité de 20 ans. L'éducation, autrefois le véhicule qui définissait l'identité culturelle nationale, assumait lors des années soixantes le rôle de force motrice dans le développement économique national. Aujourd'hui, elle assume le rôle de protecteur des industries nationales au moment où les NTI lancent un défi fondamental à la souveraineté de l'Etat-Nation.

Autre continuité, la priorité attribuée à la formation de main-d'oeuvre hautement qualifiée, la nécessité impérative de produire plus d'ingénieurs en informatique, de bio-techniciens, dans le but de réaffirmer la compétitivité nationale. Tout cela correspond d'assez près à la mentalité planificatrice des années soixantes.

Il existe quand même des différences substantielles entre cette époque et la nôtre, différences si vous voulez, qui constituent l'aspect changement. Les réformes éducatives d'il y a 20 ans constituaient une réponse de la part des gouvernements des pays de l'Ouest aux changements sociaux en dehors du monde éducatif. Les réformes étaient alors déstinées à consolider les aspirations et les attentes exogènes qui, à leur tour dérivaient de l'amélioration des conditions de vie et de l'essor d'une économie basée sur le secteur tertiaire.

Même si la continuité s'exprime pendant ces deux périodes par un besoin de main-d'oeuvre hautement qualifiée, il existe une différence fondamentale. Dans le contexte stratégique des NTI, l'objectif que l'éducation s'est vu assignée n'est rien moins que celui d'accélerer les changements sociaux prévus et ceci dans le but d'encourager le public à accepter plus rapidement les conséquences qui doivent encore produire leur impact sur la société. Et, pour terminer une autre différence : la stratégie contemporaine semble conçue moins pour augmenter la prospérité nationale que pour empêcher le déclin de se poursuivre.
Après vous avoir brossé ce tableau à la fois historique noir et contemporain, je me consacre à quelques domaines dans lesquels l'imposition des changements sociaux peut avoir un impact considérable. Ce sont: la structure de l'emploi occupationnelle et l'organisation du travail. Enfin, pour terminer, je vous ferai quelques réflexions sur la manière dont le potentiel des NTI a été présenté et débattu.

Structure occupationnelle

Il semble que l'on soit d'accord sur la direction que vont emprunter les changements dans la structure occupationnelle.

Il s'agit, dans la population active, d'une diminution rapide de la place qu'occupent les ouvriers qualifiés et spécialisés. Par ailleurs, on prévoit une augmentation marquée du nombre de techniciens ainsi que des cadres et des professions libérales. Au Danemark, par exemple, on croit que d'ici l'an 2000, les ouvriers spécialisés constitueront 15 pourcent de la population active, alors que ce pourcentage s'élevait à 35 pourcent en 1983; que les techniciens seront 30 pourcent de cette population contre 10 pourcent en 1983, tandis que la place réservée aux cadres et aux professions libérales, qui est de 15 pourcent en 1983, se verra doubler de 15 à 30 pourcent. (Morton Knudsen, "Higher Education/industry partners in education and training", paper presented at the Conference: Higher education and industry cooperation and technological change, Galway, Ireland, December 10-11th 1984).

Certains remarqueront à juste titre qu'il s'agit là d'une tendance établie qui s'est déclarée pendant ces vingt dernières années au moins. Cela est indéniable. Pendant cette époque, l'expansion du secteur tertiaire compensait la perte d'emploi dans le secteur secondaire. Aujourd'hui, l'application des NTI ne se limite pas au processus de production, ni à la chaîne d'assemblage. Elle touche aussi le travail de routine dans le secteur tertiaire, jusqu'à présent à l'abri des grands changements technologiques. En fait, les pronostics veulent que l'application des NTI mène à des pertes d'emploi dans ce secteur également (Norton Grubb, op. cit.,).

Les optimistes diront ici qu'en se débarrassant des tâches routinières grâce à l'automatisation, la qualité de la vie et les conditions de travail sont améliorées. Il se peut très bien en être ainsi pour tous ceux qui bénéficient déjà d'une certaine sécurité d'emploi. Mais cela soulève justement le problème de ceux qui n'en ont pas, qui manquent de qualifications scolaires ou professionnelles. De nombreuses études sur l'impact social des nouvelles technologies assument, par exemple, que l'accès à l'engin calculateur se fait d'une manière égalitaire et uniforme. Mais c'est justement une affirmation que l'on ne peut pas accepter sans critique. La situation dans laquelle nous nous trouvons, risque, suite aux mutations technologiques à long terme, de marginaliser un nombre important et croissant de jeunes et de moins jeunes. Les optimistes parlent comme si l'application des NTI est en soi une remède aux problèmes de base comme par exemple l'analphabétisme, les connaissances informatiques ou le désavantage. Tout cela laisse de côté un problème tout aussi important dont on perçoit mal les conséquences. Ce problème tourne autour de ce que l'on pourrait qualifier de "bagage informatique", autrement dit de capital informatique, l'équivalent dans une société de technologie de pointe du "bagage culturel" concept tout aussi usé, abusé, que connu des sociologues de l'éducation.

Les systèmes informatiques personnalisés, même si leur vente à domicile augmente rapidement, constituent encore un luxe. En dépit de toute diminution des prix, il va de soi que pour une famille, l'investissement financier qu'exige l'accès au réseaux d'information est considérable. Participer à la société informatisée présume une bourse moyenne garnie. Ce qui est le luxe d'aujourd' hui est la nécessité de demain. Mais le montant élevé des investissements en NTI suggère que les pauvres d'aujourd'hui vont plutôt avoir tendance à le devenir encore davantage. (Helga Nowotny, "The information society: its impact on the home, local community and marginal groups", in N.Björn Andersen, M.Earl & E.Mumford (eds) Information society for richer or poorer, Amsterdam, 1982, North Holland Publishing Co, p.107). En outre, bien que l'environnement éducatif évolue - pour le mieux on l'espère - les différences individuelles dans les performances, les aptitudes et les motivations continueront à exister, bien que leur définitions opérationnelles et les critères de performances puissent eux-mêmes se transformer au gré de l'amélioration de nos connaissances de l'apprentissage humain. Il se peut donc, qu'une des conséquences sociales des plus importantes des NTI soit un véritable triage plus rigoureux et plus impitoyable encore que la différentiation pédagogique et sociale que l'on voit dans notre société pré-informatisée.

Ce dernier point peut devenir particulièrement inquiétant si l'on considère que la liaison étroite entre les aptitudes, l'éducation, les qualifications et l'occupation peut selon d'aucuns, se resserrer davantage. Ainsi l'évolution de la hiérarchie occupationnelle risque de devenir plus restreinte vers le haut tout en s'élargissant vers la base, surtout si l'hiérarchie est déterminée à partir des connaissances en informatique (Nowotny, op.cit.,p.109).

Toute mutation dans la structure de l'emploi entraîne des conséquences tout aussi radicales pour les ressources éducatives de la nation, que ce soit dans le développement des aptitudes de base qu'exige la révolution à venir, ou que ce soit comme véhicule pour la rendre plus acceptable. Dans cette optique on a constaté ces dernières années un effort considérable pour augmenter les moyens consacrés aux systèmes parallèles en dehors de l'école (le système d'enseignement bis par exemple) aux systèmes de formation professionnelle ou aux programmes formation/emploi des jeunes. L'objectif assigné à ces systèmes, qui sont pour la plupart gérés par administrations d'autres que l'Education Nationale, a beaucoup changé pendant les dix dernières années. Conçus tout d'abord comme moyen de 'stocker' ou de conserver les connaissances en attendant la relance économique, ils ont vu leur tâche se muer en recyclage, de valorisation des jeunes sans qualification adéquate ou sans qualification du tout.

Ce changement d'optique dans les préoccupations des dirigeants à propos de la formation professionnelle à court terme d'une part et de l'application du principe de l'éducation permanente jusqu'à la tranche d'âge des 16 ans, de l'autre, représente une autre problématique. Celui-ci comporte deux aspects: primo, l'extension des systèmes de formation dans l'entreprise; secondo, la problématique de savoir qui de l'Etat ou du secteur privé devrait définir le profil de formation requis par la Nation.

En Europe, les systèmes de formation, conçus et gérés par les entreprises n'ont pas encore atteint l'ampleur de leurs homologues aux Etats Unis. Là, le taux de fréquentation, surtout au niveau postgradué est au moins aussi élevé que celui des étudiants dans l'université. Bien sûr, nul ne sait si l'Europe va suivre cet exemple. Mais les facteurs qui sont à la base de ce phénomène sont tout aussi pertinents dans le contexte européen.

Pour les entreprises dont la compétivité dépend d'un savoir technique continuellement mis à jour, les systèmes de formation relevant de l'Etat avec leurs objectifs multiples et leur clientèle hétéroclite, manquent parfois de souplesse. Bien que le spectacle hallucinant des entreprises qui confèrent leurs propres diplômes ne fasse pas partie de l'expérience européene, c'est le cas aux Etats Unis des grandes sociétés comme Rank Xerox, par exemple. Néanmoins, les éléments qui tendent dans cette direction ne manquent pas chez nous, non plus. L'un relève du climat idéologique, le second des considérations d'ordre budgétaire. L'aspect idéologique veut que l'intervention croissante de la part de l'Etat soit à la fois inefficace sinon néfaste pour la relance économique. Mieux vaudra laisser l'initiative aux entreprises du secteur privé, un point de vue cher aux adeptes des Reagonomics. La question budgétaire, quoique plus pragmatique, va dans le même sens. Vu les pressions exercées sur les dépenses sociales de l'Etat, on doit considérer si dans un proche avenir, l'Etat sera en mesure d'assumer les coûts énormes qu'impose un réseau d'éducation et de formation permanentes dignes de ce nom. Que les entreprises assument un rôle plus important dans la formation de leurs employés, personnel et cadres permettrait le transfert d'une partie au moins, des dépenses sociales de l'Etat au secteur privé.

Organisation du travail

La caractéristique fondamentale du travail depuis la révolution industrielle des 18 ième et 19 ième siecles, était la concentration spatiale des moyens de production, de la main-d'oeuvre et de la finance, ainsi qu'une rationalisation plus poussée du travail lui-même - ceci connu sous la forme du taylorisme. Les NTI ont le potentiel de renverser cette évolution historique et même, dans certains cas, de rétablir cette forme de 'sous-traitance' à domicile qu'on voit dans les sociétés pré-industrielles. L'augmentation du travail à domicile, payé à la piece, fait partie d'un débat assez nourri en ce moment aux Etats Unis, débat qui fait état d'une certaine ambiguité quant aux retombées sociales des nouvelles technologies. D'une part, elles sont censées apporter plus de flexibilité dans les horaires du travail et élargir les possibilités pour ceux ou celles travaillant à domicile, de bien gagner leur vie. Cependant, cette sous traitance ne figurant pas dans les accords syndicaux, elle se voit plutôt mal accueillie des grandes centrales syndicales. L'opportunité des uns c'est la menace pour d'autres.

La dispersion spatiale entraîne d'autres conséquences, tout aussi révolutionnaires dans le domaine d'espace personnel, confondant ainsi le travail et les loisirs, le domicile privé et le monde extérieur, aspects qui selon d'aucuns, permettent une amélioration de la vie ainsi qu'une réduction des déplacements quotidiens.

La domestication du travail peut, évidemment, apporter des bénéfices inestimables à la vie de famille et à ses qualités bourgeoises et consommatrices. Mais quelles seront les répercussions dans le domaine de la solidarité sociale, que sera par le résultat de ce processus de dé-solidarisation sur les mouvements politiques, les syndicats, les organismes chargés de la représentation collective des intérêts et des revendications de leur membres? Va-t-on assister à un délaissement du public, un abandon des partis politiques classiques, qui, tout compte fait, puisent leurs origines dans la division historique entre le travail et le capital? Verra-t-on au contraire, un foisonnement de groupes de pression, en dehors des partis, groupements dont la composition ne s'aligne plus sur les grandes idéologies contemporaines? (Eraly, op.cit., p.16) Ou, peut-on envisager un scénario plus sombre encore, scénario selon lequel les NTI's elles-mêmes serviraient à polariser la société entre ceux qui s'estiment bénéficiaires de la société informatisée et ceux qui croiraient lesés? Bien hardi celui qui ose faire de telles prophéties! Advienne que pourra, il n'est pas tout à fait dénué de raison que de penser que le potentiel représenté par les NTI - la fragmentation et la dispersion du travail - ne peut que d'avoir un impact des plus profonds dans le domaine de la participation et représentation politiques.

Le débat autour les NTI

Les NTI, tout comme Sir Thomas Moore, s'adaptent à toute circonstance. Pour certains, ce sont des instruments de libération personnelle. Pour d'autres, grâce à la centralisation de l'information, ce sont de diaboliques engins qui renforcent la main-mise, le contrôle social exercés des gouvernements et des grands multi-nationals. Pour d'autres encore, elles sont symboliques d'un niveau barbarisme technologique. Pour une quatrième catégorie du public, elles sont perçues comme une fatalité que la société fait mieux d'accepter faute de pouvoir dompter. Pour l'optimiste, elles sont le gage d'une société meilleure. Pour le pessimiste, c'est un tableau de l'individu entouré de son isolement qui se dresse. Ces espoirs, ainsi que ces inquiétudes ne nous apprennent rien quant aux véritables conséquences sociales de ces engins calculateurs.

La plus importante de toutes les conséquences que semble entraîner cette nouvelle instrumentalité, c'est la manière dont elle a frappé l'imagination humaine, et aussi la façon dont l'homme s'interroge sur son avenir par l'intermédiaire de cette technologie. Que de rêves sont sur le point de réalisation. L'abolition du labeur, la fin des tâches de routine, ambition qui remonte jusqu'aux utopistes français des années 1820 et 1840, par exemple. Que de réformes semblent être à notre portée. Pour les sympathisants du Reagonisme, les nouvelles technologies en réduisant les tâches moins routinières dans l'administration, doivent permettre la réduction de cet appétit budgétivore et boulimique qui est le propre de tout gouvernement. Et, ce faisant, remettre au citoyen ces pouvoirs qui, par grignotage et incurie, tombaient aux mains de l'Etat. Chacun y trouve ce qui lui plaît ou ne lui plaît pas du tout. Ainsi, l'essor des NTI alimente la dialogue, nécessaire à toute démocratie, sur les priorités sociales, économiques, industrielles qui déterminent son avenir.

Les NTI se posent, en quelque sorte, comme véhicule de dialogue sur les changements économiques et sociaux au milieu desquels nous vivons. A elles seules, les NTI ne sont qu'une partie d'une mutation globale bien plus grande. C'est, bien sûr, une partie importante et qui tout comme la pendaison qui, à croire le lexicographe anglais du 18 siècle, le Dr Sam Johnson, nous permet de saisir notre situation avec une lucidité à toute épreuve. On prétend que les NTI, surtout dans leurs retombées sociales, constituent une révolution sociale. Il se peut. Mais alors, on ne peut faire mieux que de rappeler l'élégante boutade lancée voici 38 ans par l'historien Ernest Labrousse. Dans une brillante analyse des Trois Glorieuses, Labrousse concluait, "La révolution se fait malgré les révolutionnaires". Tel est peut-être le cas des NTI.

NEW TECHNOLOGY AND THE DEVELOPING COUNTRIES
THE IMPACT ON SOCIETY AND EDUCATION
THE ADVANTAGES OF THE LATE-COMER

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Just as there are many advantages in being the youngest child in a family, so, in many ways, the late-comer to industrialisation has it better. Japan, for example, starting in the late eighteen hundreds, was able to industrialise without creating slum cities quite as harshly degrading as those of Northern England in the first half of the nineteenth century described by Engels and Dickens. The technology of public health had made considerable advances by the time Japan was developing industrial cities -- and so had ideas about what it was appropriate for governments to do to combat epidemics, and so had the social technology of municipal government -- knowledge of how effectively to organise large cities -- something which Japanese officials came to Europe to study when Japan's local government system was being revised in the 1880s.

In production technology, too, Japan could move, in steel, say, straight into 1890s steel-making technology without going through all the painful, inefficient processes of trial and error through which that technology had been developed in Britain and Germany and the US. Japan never went through the canal age, but jumped straight into the railway age, just as many modern developing countries are going straight into the road transport age with hardly any experience of rail.

This learning from others' mistakes and development investments is only one of what the economic historian Gerschenkron once called the advantages of backwardness -- if quite possibly the most important. The other aspect on which Gerschenkron concentrated, was the way in which the intellectuals and political leaders of developing countries are afflicted by -- or stimulated by -- a sense of their own nation's backwardness -- which adds a national dimension, a dimension of central planning or collective effort, to the market forces which provided the main engines of growth in the countries which industrialised earlier. Industrialisation comes, not simply as the cumulative consequences of the efforts of myriads of individual entrepreneurs and farmers, each pursuing his own profit -- a result of the working of the invisible hand -- but in part as the consequence of a deliberate drive to make Ritardania great, to enable its citizens to hold their heads high as members of one of the leading nations of the world. Nowadays, of course, now that free market ideologies have gained such hegemony -- at least in the Anglo-Saxon world that I come from -- no one will believe that the involvement of the state can make any contribution to the growth of the economy, but suffice it to say that, whatever the ideology they profess, most governments in the world today behave as if they believe otherwise.

It does seem, at any rate, that through the one mechanism or the other the rate of growth in late-developing countries is a good deal faster than it was in the early stages of industrialisation of the pioneer developing countries. It seems that the later you start the faster you grow. France and the US grew in the nineteenth century faster than Britain. Germany grew faster than either of them two. And Japan faster than Germany. Then more recently, South Korea and Taiwan have grown faster than Japan. Economists speak of this phenomenon as the 'catch-up'-effect. It is not an universal or inevitable process, not every developing country is a South Korea or Brazil. The size of the technology gap between the leading industrial countries and the developing countries represents only a potential source of fast growth. Whether that will or will not take place depends on many conditions, notably the nations intellectual and organisational resources. And it is here that the educational system becomes important.

A nations schools have a lot to do in the first place with the level of national consciousness and sense of national cohesion. This is an important factor determing the ability of the state to mobilise the resources necessary for the drive to catch up. Without the sense of Koreans, shared by all the Koreans, the control of technology import, the selective credit system of the Korean governement, the directions of certain kinds of productions towards exports necesarry to maintain continuing import of capital goods, all that would have been much more difficult.

And secondly and additional to creating a national consciousness, the education system also shapes the intellectual resources which a nations has available to absorb and master the technology which have been developed elsewhere. Because in the end it is the absorption and master that counts. We hear a good deal of talk of "technology transfer". It is common to think of this primarily in hardware terms. If I.G. Farben build an ethylene glycol plant in Indonesia which uses the latetst chemical technology and is wholly owned by Indonesian capitalists, that is technology transfer. And so it is, in a way, or at least the beginning of technology transfer. But it is only the beginning as long as there are German technicians there supervising the running of the plant, as long as crucial spare parts can only be imported from Germany and as long as German experts have to be called in when plant refurbishing and maintenance is required. Only when there are Indonesians who understand enough of the workings to deal with all production and maintenance difficulties; only when some of them have the underlying theoretical knowledge used in the plants processes and when that knowledge is incorporated into university chemical engineering courses so that it can begin to be locally reproduced; only when Indonesian firms become capable of building a similar plant -- only, in short, when the knowledge which went into the making and the maintaining of the plant is transferred fully from German heads to Indonesian heads -- can one say that technology transfer has taken place.

The phrase "independent technological capability" has come into vogue amonst students of developing countries in recent years. It refers precisely to the capacity -- the intellectual and organisational capacity -- to accomplish this process of absorption and mastery which constitutes technology transfer. It is not, of course, an all-or-nothing thing. It would take a very long time for most European countries to master state-of-the-art space technology in the fields in which the US has a near-monopoly, for instance. In that sense "technological capability" is a matter of more and less.

Catch-up getting harder

And the first thing to be said about the new technology is that the distance between more and less, the size of the technological capability gap between the leading nations and the developing nations, is growing all the time in ways that make the process of catching up, of absorption and mastery, increasingly difficult. The technology which Japanese engineers had to absorp in the 1890s in order to produce steel as good as the steel currently being produced in Germany was intelligible to people who had finished a secondary education plus, perhaps, a year or two's study of what then passed for the latest theoretical knowledge of metallurgy and chemistry. Today, understanding the theoretical knowledge embodied in a modern continuous casting plant would be the work of several specialists, metallurgists, chemists, electronics experts, each of whom had spent several years in systematic study.

We talk frequently nowadays of "the new technologies" and sometimes of the "microprocessor revolution", as if we were witnessing some discontinuous change in the technological sphere. There is perhaps something special about micro-electronics as a generic technology with implications for a wider range of spheres than almost anything since the development of electrical energy and electro-magnetic applications. But generally I see our current concern with technological change as the result not of any once-for-all discontinuous change in our technology, but rather as a sign of a general realisation of the fact that the pace of technical change has been slowly accelerating. With a steady increase in all the industrial nations in the percentage of national income which is spent on R & D -- combined with a steady increase in the national income of which it is a percentage -- it is not surprising that it should be so. The accumulation of scientific knowledge and of the stock of usable technology changed to a new gear in the nineteenth century when governments began giving funds to institutionalise the process of research in universities and again in the twentieth century when industrial corporations began hiring inventors and establishing research and development departments. Those processes of institutionalisation have allowed the rate of knowledge accumulation steadily to accelerate.

And, to revert to developing countries and their problems, the first general proposition which suggests itself is the obvious one: the more time goes by, the more advanced the world process of knowledge accumulation, the more daunting the developing country's task of catching up becomes, the greater the expectations placed on the education system becomes, the greater the strains to which it is subjected.

Education and Selection

The first source of strain is the intensification of the tension between the function of the school as an educational institution, a means of moulding the hearts and minds of future citizens, and its function as a mechanism of social selection -- the practice grounds in which members of the next generation compete with each other for the most desirable positions in society. I once wrote a book about this phenomenon and its particular consequences for developing countries under the title 'The Diploma Disease'. The argument, briefly, was that this tension between the two functions of schooling, has been present in every modern school system since the bureaucratisation of employment began -- since a majority of the population began to derive its income, not from selling goods and services in the market but from an employee position -- often with secure tenure -- in a large organisation, a position gained in a competition in which educational qualifications play a decisive part. And that this tension had several consequences in all societies -- a tendency for school learning to become more and more examination-oriented as qualifications acquired more and more bread-and-butter value, with the result that learning became more instrumental and ritualised and less effective in forming productive work attitudes and work capacities; secondly, a tendency for the school system to become a univalent pyramid, for everybody to be trying to climb to the top of the same tertiary sector, with the consequence, for instance, that secondary-level technical education becomes devalued, seen simply as a second-best spill- over facility for people who do not qualify for the royal road to university -- and who often refuse to accept their fate, and neglect their vocational subjects in order to redouble their efforts at the academic subjects, preparing for second-chance exams which will take them back on to the main road again; thirdly, the tendency, when examination success is so highly valued, for educational resources and the attention of teachers to be concentrated on the able pupils, to the neglect of the needs of the slower learners.

All of these problems are exacerbated in developing countries by a number of circumstances. First, the social contrast between the conditions of employment in the bureaucratised diploma-requiring modern sector and those of the traditional, especially the agricultural traditional, sector of the economy -- the gap in wage levels and in levels of security and social prestige -- is much larger than any disparity in life-chances which exists in the industrial countries, and the incentives to succeed in the examination race are consequently that much greater.

Secondly, in the industrial countries, class differences in aspiration often damp down the examination competition -- large sections of the working class do not expect their children to reach the universities which are seen primarily as middle-class institutions. And much the same is true of Latin America. But such class differences are not present in many of the newer developing countries, especially the newer countries of Africa. The present, first-generation, elite if often made up of village boys who made good through the educational system, and every village boy in the nation sees himself as competing for the chance to follow in their footsteps.

Thirdly, the emotional and cognitive gap between home and school is a good deal greater in developing countries. The disjunction between the values and the intellectual assumptions -- the "common sense" -- of the traditional society (often until very recently societies of primitive hand-hoe agriculture), and the values and intellectual assumptions of a school curriculum derived directly from what counts as common sense in Western societies, is often very large, and unsophisticated teachers are often much more in tune with folk common sense than they are with the common sense embodied in their curriculum. As a result, the tendency for the subject matter of the curriculum to be treated purely instrumentally, as having no meaning except as a means of social ascension through the examination ladder, is thereby exacerbated.

Finally, a fourth reason why diploma disease tendencies are so much stronger in developing countries is because of the unemployment problem -- because it is cheaper and easier to expand the school system and even the university system, than it is to create economically viable factories and newspapers and hospitals and other service organisations. The pressure created by the graduate unemployment problem tends to skew educational expenditures towards the upper echelons of the system. At Stage 1 all the concern is with unemployed primary school leavers, and all the pressure is directed at building more secondary schools to accommodate them. At Stage 2, nobody any longer expects primary school leavers to be able to get wage jobs in the modern sector, and all the worry is about unemployed secondary school leavers, and the political campaigns are about more universities and polytechnics so that they can qualify for the jobs where demand and supply seem still to be in balance. But by the time they graduate, there is over-supply, and then there is talk of a need for more masters' courses. And with every step in the escalation, the primary schools which are educating the next generation of farmers -- the men and women whose ability to raise farm output is often the make-or-break question for the economy -- get more and more starved of funds.

The impact of new technology

What effect will the new technologies have on these problems? In mineral-rich economies which have no very tight constraints on capital expenditure, there is no doubt that some of the new communications technologies, particularly the use of video cassettes, could help to make up for the deficiencies of teachers and improve the quality of education, particularly in rural areas -- provided that there is manpower enough to write suitable material, or even to adapt foreign material to local languages and circumstances. And given the difficulties many countries have in building up and keeping a vigorous and imaginative curriculum development unit, that remains a very big proviso.

An indirect effect of developments in technology, however, may well be to intensify the problems of what I called the diploma disease. A scientific education will be more and more at a premium. Already, in many developing countries, the most intense competition occurs at the point in the secondary cycle when pupils are divided between those who will follow the science courses and have a good chance to end up qualified as engineers or doctors -- with almost guaranteed employment and high salaries -- and those who are assigned to the arts courses. And in the univalent pyramid system I spoke of, this forking of the ways is usually perceived as a matter of "succeeding" in getting into the science courses or of "being relegated" to the less desirable fate of the arts -- not as a moment of choice when each selects the course best suited to his aptitudes and abilities. As technological expertise becomes even more highly prized these tendencies can only be intensified, thereby reinforcing the univalence of the system. And thereby reinforcing also, perhaps, some of its other consequences. It is characteristic of an intensely instrumental attitude towards schooling, as primarily a means of gaining the diplomas which earn a desirable position in society, that it can fail to impart a genuine taste for the process of learning itself. The diplomaed man, particularly if he gets employment in a bureaucratic organisation and gets his foot on the bottom of a more-or-less automatic-promotion ladder, is likely to see himself as a complete man, who has done all the tedious learning he ever needs to do and can now sit back and enjoy the fruits of all his meritorious effort. It is an attitude in sharp contrast with the lifelong-learning ideal, and it is a platitude that the pace of technical change today makes lifelong learning, and an appetite for lifelong learning, a necessary prerequisite for doing most high-level jobs well.

But these are not the only ways in which the situation of developing countries is going to be complicated by the acceleration in the pace of technical change. There will be effects on the employment problem, and the brain-drain problem, there will be consequences for national integrity and for nationalism; consequences also for the difficult choices which all developing countries have to make between external dependency and self-reliance.

The employment problem

First of all, the employment problem. There is a vast literature of technology choice in developing countries, a lot of it variations on the theme that countries should choose the technology which is most suited to their factor endowments. If labour is abundant and capital is scarce, then they should be very hesitant about using labour-saving machinery, particularly if they have to import it. In practice, such advice is rarely followed because, quite apart from engineers' pride and insistence on the latest and the best, the choice of techniques is not simply a matter of relative costs. Machinery may be more reliable than a recalcitrant labour force. Even with no recalcitrance problem, even with the best will in the world, high product quality may be more easily attained with machines than by human agency, however skilled. The latest computer-numerically-controlled machine tools for instance can machine metal parts to much more complex shapes to much finer tolerances than human beings can. Add to this the fact that some forms of mechanisation represent such significant savings that not even the cheapest of human labour can compete with it -- a lot of computer operations now that microprocessors have become so cheap, for instance.

For all these reasons there is no doubt that the new generation of process innovations in machine tools and in communications and office work will rapidly find its way into developing countries too, as the preferred choice of technique whenever investment can be afforded.

We hear a lot today in the industrial countries about the problems of unemployment caused by the advent of new technology. Or, to be more precise, we hear a lot about it in Europe where the problem is more marked than it is in either the US or Japan. There is more than one reason for the difference, but one important factor lies in the different capacities in Europe, Japan and the US for product innovation as opposed to process innovation. Europe is not backward in adopting the new capital goods which lower costs and improve qualities by displacing labour. But all too often those new capital goods are the product of Japanese or of American industry. Societies which are equally capable of product as of process innovation create new jobs to replace the ones which machines make unnecessary. Societies which are not have trouble. And the troubles of the developing countries, with even lesser chances of sharing in the world production of high technology exports even than Europe, are likely to be many times more serious.

The brain drain

As for the brain-drain, the point is a simple one. The size of the brain-drain a country suffers depends partly on salary and quality of life differentials, but partly also on the intensity of contact with foreign countries, particularly of study overseas. Higher levels of technology -- or rather an acceleration in the rate of accumulation of technological knowledge -- mean that the process of localising the transmission of knowledge becomes tougher; study abroad remains indispensable, particularly, of course, for small countries.

Back in the nineteenth century, when new technology was accumulating more slowly, the Japanese could build up a university system which was capable of transmitting the stock of world knowledge in a pretty up-to-date form -- as up-to-date and in touch with industrial practice as engineering education ever is -- in the Japanese language. In the 1870s and 1880s a lot of the lectures in Tokyo University were given by foreigners and in English or German. The last English lectures, given by the last irreplaceable foreigner, were those in naval architecture, and they ceased in 1910. Today, a China with its size and manpower resources might hope eventually to do something similar -- unlike, say, a Sri Lanka or even an Indonesia. But even China will need for a long time to have a high proportion of its technicians and scientists capable of using English, and will need to send a good number of students to study abroad.

In part this is simply a function of the knowledge explosion and of the increasing degree of specialisation in science and engineering. No country, not even the most advanced in technology, can hope to be the leader in every field. There will always be things that the Americans can learn in Japan and that the Japanese can learn in America. In fact, a growing interchange of doctoral and post-doctoral students between those countries is symptomatic of the process of internationalisation which is at work. And for countries which can hardly hope to be technological leaders in any important specialty, this process of internationalisation means, at the same time, increasing dependency. At best, it means dependence on foreign teachers to help one's own nationals to acquire mastery over the computers and the agrobiology and the medical equimpent one's society uses. At next best, it requires occasional resort to foreign manufacturers for the repair of the equipment when it goes wrong. At worst, it requires resort to the services of foreigners simply for the effective use and routine maintenance of the equipment.

The dependency syndrome

Dependency is never a very healthy state of international relations. It is particularly irksome for poor countries and for the leaders and intellectuals of poor countries who are, among their fellow-countrymen, most frequently in contact with foreigners and may have most directly to experience the arrogance and off-handedness of people who are richer and more powerful than themselves -- or who simply wear an air of superiority by virtue of the fact that their country is richer and more powerful. So central a concern has this been in developing countries -- particularly among the university intellectuals of Latin America where resistance to the political dominance of the United States has always been a central theme of national politics -- that what was known as "dependency theory" came to occupy the centre stage for those who theorised about development in the English-speaking countries in the 1970s.

At its most developed, the theory involved a set of postulates about the relation between external dependency and internal class structures. The dominant bourgeoisie perpetuated external dependency basically because they were bought, because they were a comprador bourgeoisie which drew substantial rents from the mechanisms whereby the dominant metropolitan powers exploited the developing countries. The model clearly had a certain applicability, at least to Latin America or to Kenya, if not so obviously to India. It led to the prescription of an alternative strategy of self-reliance, of delinking from the world capitalist system, but usually only after a revolution to overthrow the compradors. So powerful and widespread was the sentiment, if not the doctrine, of rejection of dependency that, for instance, the Monrovia Declaration of the Organisation of African Unity, speaking in 1979 of the prospects for Africa in the Year 2000, and of the need for developing countries to develop their own technology, declared that "the term 'technology transfer' should be stricken from our vocabulary".

What that prescription overlooked, however, was the cost of self-reliance, the fact that of all the imbalances of power, the imbalance of technological sophistication remains the least easily cured in a short space of time and that if one does seek to avoid any kind of knowledge dependency on foreigners one might be condemning oneself to unnecessarily low levels of productivity and of growth.

The strategy of self-reliance

The acceleration of technological change and the appearance of the new technologies accentuates that dilemma. The history of India's development strategies since independence is symptomatic. If to a less extreme degree than China in the decade of the Cultural Revolution, India has adopted a strategy of maximal technological self-reliance. The development strategies of the economist Mahalanobis, which inspired the early economic plans, followed the Russian development strategy of first building up a technological capacity in the basic capital goods industries, thereby laying a foundation for subsequent industrial development. The indigenous industries were given tariff protection as they were built. There were strict controls on the import of foreign technologies and strong state backing for research institutes which were to cater for India's own technological needs -- developing a real Hindu technology as the Delhi wits had it. All these measures were designed to ensure that the political integrity and independence of the Indian nation was not compromised by any kind of technological dependency.

In a way it worked. India achieved a very high level of self-sufficiency. The cadre of home-trained engineers grew significantly, and so did their sophistication. India acquired a full range of modern industries -- but by and large industries which used, and were not able to upgrade, out-dated technology. The result was stagnation and an inability to compete in world export markets with goods of the quality which those markets required. The result was also a rate of economic growth much lower than a country with India's rates of population increase could afford, and much lower than countries like Korea and Taiwan were achieving with more open strategies.

Open strategies come in two kinds. There is the openness of a Guatemala, a weak state, minimal sense of nationalism, controls on the activities of foreigners and the import of technologies being imposed, if at all, primarily in order to extract bribes for the privilege of evading them. The other kind of open strategy is that of a strong state like those of Japan or South Korea or China or Taiwan, states animated by a very strong sense of nationalism which does find very irksome indeed any dependence on foreign governments, on foreign corporations and on foreign teachers. In this kind of openness, however, the nationalism is accompanied by a strong sense of realism, an acceptance that catching up requires the humility to accept the status of pupil, to invite the foreign firms which have something to teach into joint ventures and to be satisfied with the best terms one can get. Behind that strategy lies a certain confidence, a confidence that in the end one will be able to catch up, that one's intellectual resources are capable of doing the job and that one's state of backwardness is only a temporary condition, product of the accident of history.

The relevance of this discussion to our theme is simply this: the more rapid the production of new technical and scientific knowledge in the industrial countries, the greater this tension between the two faces of nationalism -- on the one hand the rejection of dependency, and on the other the determination to make one's country strong and prosperous by learning, as rapidly as possible, the latest and best technology available.

The cultural sources of confidence and competence

The confidence that one can do it -- the confidence that one's own country can eventually join the ranks of the prosperous industrial countries -- the confidence which the Japanese had and which the other countries of the Confucian cultural sphere clearly have today -- a confidence shared, perhaps by Brazilians and Mexicans and intermittently by Indians -- is probably the crucial variable.

And, to come back finally to the educational system again, it is interesting to speculate on the meaning of the fact that the countries which have shown that confidence are, by and large, the countries which had some kind of formal school educational system well before the modern period -- peasant societies for the most part within the sphere of one of the great world religions. We generalise too easily about the developing countries, without attending as much as we should to the differences between them. UNESCO statistics count a year of schooling or of university study in Senegal and Tanzania as in every respect equivalent to years of schooling in Korea or Brazil. And so, in some respects they are: the curricula may be very similar. And yet we may be wrong in expecting a society's capacity to absorb technology, and to apply it to the task of economic improvement to be directly related to such indicators as the amount of schooling the population has received.
Differences between societies in what passes for folk knowledge, for proverbial wisdom and commom sense, assumptions about causality and about morality, the standards of judgement applied to human action -- all those things which are the result of a slow cumulation of culture over centuries -- may be far more important.

We who are professionally involved with schools and who have a vested interest in emphasising their importance, should never forget that even the child who gets a pretty full schooling and spends, say, 14,000 hours of his childhood life in school, is still likely to spend 70,000 of his waking hours outside of school. Only as the first schooled generation begins to influence those 70,000 hours of its children, and they in turn the out-of-school hours of the third generation -- only through those processes of gradual cumulation does the effectiveness of the implantation of schools in a society begin to show itself. We should not expect too much too quickly.

And meanwhile, perhaps, as we become more and more preoccupied with the intensification of international competition in the world economy, more and more concerned with how we are doing in the three-horse race: Europe, US and Japan, we should think more often about the countries which are not able to compete in the same league but which have far more desperate needs than we have to harness new techniques to the mastery of their diseases and the husbandry of crops and to the effective utilisation of such resources as they happen to be endowed with. And we should recognise that even if we can persuade ourselves to be more generous, both in devoting some of our scientific manpower to their problems and in transferring already developed knowledge to them on better than commercial terms, the process of absorbing and mastering foreign technology and of dealing with all the social and ideological implications of that learning process, is not a simple problem. It never was a simple problem, and it gets worse as mankind's stock of knowledge accumulates and the knowledge gap between the rich and the poor countries continues to grow.

Part.II

Papers

TECHNOLOGICAL CHANGE AND POLITICAL AWARENESS IN ADVANCED INDUSTRIAL SOCIETIES

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Descriptions of advanced industrial societies in the post-1945 period have frequently emphasised the scientific technological nature of the development of such societies. Contemporary positivists have hailed technological development as the cornerstone of social progress, while technological determinists have sought to show its inexorability. It is widely accepted that there has been an exponential growth in scientific and technological activity since World War II. Since the work of scientists has been increasingly in applied fields, the tradtional, popularly-held distinction between science (concerned with the 'discovery' of 'laws of nature') and technology (concerned with the application of science in order to exercise human control over the environment) has practically diminished: hence the concept of scientific-technology. Additionally, we should note that the concept of scientific-technology has also come to refer to the increased knowledge basis of technological development, as opposed to developments in the past which were based rather more on intuition and ad hoc processes. One of the major characteristics, therefore, of the advanced industrial societies is the phenomenon of scientific activity in conscious pursuit of technological goals and technological activity consciously dependent upon scientific research. This is arguably what constitutes the 'new industrial revolution'.

This 'new industrial revolution' raises important issues concerning the relationship between technological development and society. These issues must be explored in order to arrive at some understanding of the relationship between technological change and political awareness. Here we encounter two opposing perspectives: the first, that technological development is subordinated to social processes, and the second, that social processes have become subordinated to technological development. In reality, however, these two perspectives frequently converge. An orthodox Marxist view of innovation in manufacturing technology in the 19th century - in the forces of production - suggests there was little in the way of choice. In practice, technology determined the pattern of social relations; in other words, technology in the static sense possesses a certain autonomy since instruments of technology were easily detached from their social contexts. But technology in the dynamic sense - as a process of development - was socially and economically constrained. Consequently, there was no reason why James Watt's steam engine should not have been applicable in all kinds of societies, but, initially, in capitalist England, it could not have reached the final stage of development without entrepreneurial support.

However, there are forceful arguments today which suggest that since 1945 technology in the advanced industrial societies is itself a prime agency of social change. A whole series of developments have significantly affected, and are continuing to affect, the social and economic fabric. Scientific-technology has gained a self-momentum, where innovation ietself has become an industry, and consequently, a socio-economic force; not only does scientific-technology have relative autonomy, it also dictates the manner in which social relations themselves are constituted. Technology has extended human capabilities in a qualitative fashion, at the same time ensuring that desired effects are produced with the minimum of waste. As with traditional machine production, the application of advanced scientific-technology demands division and specificity, but - to use the language of information technology - within a more digital framework (as opposed to the analogue perspective of 19th century factory industry). The digitalized elements of production are required to be integrated through a process of centralized control - as we can surely see in modern computerized systems of industrial manufacturing.

Scientific-technology thus seems to impose an order demanding a kind of obedience in the acceptance of a functional status quo. To conceive of technology in terms of 'tool use' is to be anachronistic - and yet, of course, reflects the fact that the prevailing conceptual framework in advanced industrial societies is one which is based on a traditional technological order. As a result it might be thought that the notion of technological politics becomes relevant. Here, human ends are adjusted to the available technological means and technological norms are central human values. Ends must be defined precisely to suit prevailing techniques so that, for example, the desire to communicate is defined as a demand for a telephone or that music appreciation is seen as hi-fi ownership. Technological politics, as those such as Herbert Marcuse have argued, completely negates the notion that technology is ultimately subject to human control. Rather, the opposite is the case in the advanced industrial societies, for it would seem to be that it is the structure of technical achievements that largely determines what are actually human problems, that is to say, political problems.

This perspective on scientific-technology can be illustrated through a brief examination of the nature of information technology. The microprocessor - the heart of the modern computer - has been judged to have inevitable consequences for employment (in addition to social control and issues of privacy). It will tend to reduce the amount of time spent on manufacturing a product or producing a service because of either a reduction in the number of components needed in many products or because of the automation and speeding-up of production lines and office operations. This is now a reality and is reflected in the incorporation of robotics in engineering studies in many institutions concerned with technical education and wordprocessing in the training of typists. The assumption is that the application of microprocessor technology calls for training in new skills; the greater likelihood, however, is that it leads to a significant fall in employment (even in the electronics industry). There has been talk of the 'collapse of work', quite apart from the effects of economic 'resession' (or of the policies of governments), with previously labour-intensive industries either disappearing altogether or else becoming relatively capital-intensive.

Now, we might argue that microprocessor technology itself does not determine the future of society but, rather, invites new choices. It is not inevitable that the new technology will merely strengthen the social order of advanced industrial capitalism; it surely carries with it the equal possibility of transforming that social order. However, in previous times when technological changes occurred at a slower pace and when social institutions (especially those concerned with the political order) were relatively stable, the kinds of choices open to those in positions of power were rather limited. It was taken for granted, for example, that work was a central activity (for all but a few) in industrial societies. But, if the 'collapse of work' is the major outcome of the new technology the very concept of work becomes problematic, having serious implications for the political cultures of the advanced industrial nations.

One central value, the Protestant Ethic, has become deeply embedded in advanced capitalist societies. Indeed, it has provided the framework for political thinking in all advanced industrial societies. Max Weber related this ethic of "...'proving' oneself before God..." to "...proving oneself before men..." in the context of the ethos of the bourgeois middle classes (1). As the

Protestant Ethic became generally known as the 'work ethic' it permeated the value system of all classes and all established political ideologies. Not least has it become taken for granted by those who work within the education systems of these societies. Yet the perpetuation of the work ethic in a world where work is rapidly disappearing is somewhat contradictory. It is noticeable, however, that contemporary programmes of 'vocational' training (i.e. training for the 'world of work' rather than for a specific occupation) have continued to promote the work ethic as an essential element in the flexible workforce of the future. Thus, young people in the advanced industrial societies are being told on the one hand that they should continue to adhere to norms of diligence and on the other that they should recognize that work as it is commonly understood may no longer exist.

More significantly, the issue of employment ceases to be seen in political terms but rather is an aspect of technology and management. Work is no longer the outcome of particular patterns of social organisation, of decision-making processes, or of a particular value system, rather it is the outcome of technical-managerial imperatives. Here, we see what is arguably one of the most significant consequences of technological change in contemporary advanced industrial societies: the reduction of political-moral issues to technical-managerial issues. It is, as Habermas suggests, the abandonment of "...the substance of power in favour of an efficient way of applying available techniques in the framework of strategies that are objectively called for" (2). In this way, political decisions are translated as technical decisions: they are purely 'objective', being taken on the grounds of efficiency. (It is, of course, interesting to note how post-war conservative and social-democratic governments in Western Europe have taken decisions allegedly on the grounds of efficiency rather than according to political ideology).

It will have become apparent by now that while I consider that scientific-technological change has had a fundamental effect upon the political cultures of the advanced industrial societies, I do not accept that this is the consequence of some 'technological imperative'. Issues of scientific-technology inevitably incorporate issues which are political and moral in nature. On the other hand, the way in which such issues are presented has tended to inhibit political debate, thus excluding discussion of such issues from the public realm. If debates about developments in scientific-technology are presented within a non-political, 'technicist' framework, where professional expertise is the sole criterion for understanding, then we may conclude that such debates, far from being 'objective' in character, are in fact quite ideologically based. To put it more precisely, technological change has ideological force because of the tendency to ignore its social and political implications.

In part, the presentation of technological change within a non-political framework has its roots in the 19th century belief in the inevitability of progress. This belief returned in the post-war era under the guise of the 'end of ideology' and the termination of political conflict heralded in the wake of rapid technological advance. At the same time there was a failure to recognize the institutional context of scientific 'progress', contributing to the legitimation of the existing framework of political power through a process of depoliticization. As Habermas has stated, questions of practice have become absorbed into questions of technology (questions, as previously stated, to which the answers can only be found by 'experts'). Thus, as politics, as understood within the parliamentary, liberal-democratic tradition, is excluded decision-making becomes a technical issue. Here, one view is that the advanced industrial societies of Western Europe and North America merely indulge in plebiscitary action every so often which requires little if any political awareness. Habermas once more points out that advanced capitalism, being dependent upon a 'depoliticized public realm', strongly resists"...that unrestricted communication about the goals of life activity and conduct..." which is necessary for the growth of political awareness (3).

What, then, are the consequences for the promotion of political awareness? If political education, as conventionally understood, is closely tied to the national political cultures of advanced industrial societies, it is unlikely to fulfil its goal in an era where scientific-technology has appeared to undermine the very basis of those cultures. The conservative model of political education, emphasising the importance of tradition, custom, and the attitudes associated with the prevailing political-economic system, is at best irrelevant and at worst a device for concealing the nature of contemporary society. Arguably, a more liberal model which emphasises the acquisition of knowledge, attitudes and skills associated with political activity in parliamentary democracies would be an improvement. However, this model also falls into the gap of isolating politics, of perceiving political education as concerned with the apparatus of government and elections.

I would therefore suggest an alternative approach: one which considers an examination of scientific-technology and its implications as a more meaningful contribution to the promotion of political awareness. This could be particularly significant at a time when there have been curricular changes affecting the

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education of those at the upper secondary and post-compulsory levels. The emphasis on vocational education and training in an era of economic recession and youth unemployment has been felt throughout Western Europe. National governments have been in the forefront of initiating changes in educational practice, often stressing the importance of technological change and its effects on the job prospects of young people. It is no longer appropriate to continue with established modes of vocational training for they merely perpetuate a false view of reality, that jobs requiring the possession of traditional skills will eventually reappear. Technological change in the late 20th century means uncertainty and therefore demands training for flexibility; consequently, the notions of 'vocational preparation' and 'transferable skills' become paramount.

As increasing numbers of young people find themselves forced out of the labour market and back into the educational (or quasi-educational) system new opportunities for the promotion of political awareness might present themselves. Central to many programmes of vocational preparation is an appreciation of information technology and its applications, whether in the 'electronic office' or industrial automation. The extent to which such technological developments are examined in a detailed, critical manner remains to be judged; much depends on the structures within which vocational preparation takes place as well as on those who are the educators/trainers. Here, we are not only dealing with what might actually constitute technological education, i.e. whether it involves a non-positivistic perspective on science and a consideration of the political and economic implications, but also the proposition that educational/training institutions can operate in a relatively autonomous manner. Clearly, this would demand some kind of empirical approach, bearing in mind the diversity of education systems in the advanced industrial societies.

Central to this discussion has been the notion of technological determinism. Its acceptance suggests that in the final analysis scientific-technology is a mystery and, therefore, outside the control and understanding of individuals. While it may appear that post-war technological change in the advanced industrial world has increasingly been seen to determine social, political and economic changes, I would argue that the picture, in reality, is rather different. A more accurate view would be that technological change takes place within a complex web of interaction in which dominant ideologies, economic forces, and scientific-technological practice are all significant. It may be that the increasing domination of 'new' technology reflects an increased propensity for centralised social control; it may certainly make it easier. On the other hand, until developments in artificial intelligence result in complete machine autonomy we cannot, in truth, give primacy to technology. In which case, those who teach in the fields of science and technology, and especially those who are increasingly involved with vocational training and education, might find themselves able to perform a vital role. The role is that of political educator - not in the sense of being the teacher of civic virtues or of political skills - but of helping to de-mystify technology and to lay bare the underlying values, beliefs, and power structures.

Notes

1. Gerth, H.H. and Mills, C.W., From Max Weber, London: Routledge, 1948, p.321.
2. Habermans, J., Toward a Rational Society, London: Heinemann, 1971, p.64
3. ibid. p. 120.

LA PLANIFICATION DE L'ENSEIGNEMENT CONFORMEMENT AUX EXIGENCES DU MARCHE DU TRAVAIL.

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1. Le point de départ

Tout enseignement vise à intégrer l'individu dans la société. Il doit donc considérer l'individu comme une entité socio-culturelle qui, à côté de son individualité, est aussi porteur de valeurs propres à la société à laquelle il appartient. Pour l'économiste cela veut dire que l'enseignement est un bien social qu'on ne peut mettre à la disposition des utilisateurs, suivant les seules lois de l'offre et de la demande. L'enseignement n'est pas seulement investissement. Il faut aussi tenir compte de considérations extra-économiques afin d'éviter des distortions sociales et culturelles. Cela nous mène à une définition de l'enseignement comme un système de stratégies individuelles et collectives, visant à procurer des qualifications individuellement et socialement désirables.

Il va de soi que l'application de cette définition conduit à des jugements de valeur concernant le degré de désirabilité des qualifications. L'économiste évite cette difficulté en rétrécissant le champ d'observation. Au lieu de s'aventurer dans un domaine qui n'est pas le sien ("Qu'est-ce qui est individuellement et socialement désirable?"), il va se contenter d'observer la réalité en essayant d'en distiller les valeurs factuelles qui régissent la vie d'une société concrète. En matière d'enseignement cela correspond à se demander quelles sont les qualifications que les individus veulent acquérir et quelles sont celles exigées par la société? En d'autres termes, il va explorer l'offre et la demande de qualifications en ayant soin de les traiter séparément comme données de base pour tout modèle ultérieur.

L'offre de qualifications est l'expression des préférences individuelles et se traduit tout simplement par le nombre d'élèves ou le nombre de diplômes par spécialité. La demande de qualifications reflète les préférences sociales, c-à-d les qualifications que la société considère comme désirables. Pour connaître celles-ci il suffit d'analyser le marché du travail et plus spécialement le côté demande de force de travail de la part des employeurs. En confrontant les deux, il est possible de construire un modèle de planification de l'enseignement qui tient compte aussi de considérations extra-économiques.

L'idée d'un tel modèle est illustrée par la Figure 1.Les ménages (HH) génèrent une demande d'enseignement (DE), qui se confronte à une offre d'enseignement (SE) sur le marché de l'enseignement (EM). Ce dernier est défini comme l'ensemble des relations d'offre et de demande de services scolaires procurés par le système d'enseignement (ES). Ce marché a comme fonction d'une part d'informer les ménages des possibilités offertes par le système d'enseignement et d'autre part d'informer ce dernier des besoins manifestés par les ménages. Schématiquement cela se traduit par les deux courants d'information (IS) qui quittent le marché de l'enseignement. Il en résulte une production de qualifications (PQ), c-à-d les écoles organisent des cours et délivrent des diplômes. Le rôle joué par les écoles s'arrête virtuellement ici, car la décision de se présenter ou non sur le marché du travail dépend en principe des diplômés eux-mêmes. Sur le schéma, il n'y a donc pas de courant direct entre PQ et le marché du travail (LM), mais bien indirect en passant par les ménages. La production de qualifications se transforme ainsi en offre de qualifications (SQ), qui se confronte à la demande de qualifications (DQ) sur le marché du travail. Le résultat final est l'emploi et la production des biens (PC).

Bien que PQ et SQ ne doivent pas être égales en termes quantitatifs, nous pensons ne pas nous éloigner trop de la réalité en les supposant égales. Cela veut dire que nous acceptons l'hypothèse que chaque diplômé se présente effectivement sur le marché de travail. Le grand problème par contre se situe dans la relation qui existe entre SQ et DQ. Dans la mesure où SQ>DQ il y a sous-emploi et le gouvernement doit intervenir avec des mesures visant à stimuler l'emploi. Il se peut que les raisons d'un tel déséquilibre soient de nature purement économique (par exemple instabilité conjoncturelle) et n'aient rien à voir avec la structure de SQ et par conséquent avec l'enseignement. Mais il y a aussi sous-emploi si la structure de SQ ne correspond pas à celle de DQ, même dans le cas où SQ=DQ, voire SQ<DQ. Cela signifierait tout simplement que la force de travail n'a pas les qualifications requises par le système de production, suite à un mauvais fonctionnement du marché de travail et plus spécialement des courants d'information (IS). Ces derniers peuvent être ou bien trop faibles pour être perçus de façon effective, ou bien négligés par les partis intéressés. C'est ici que le gouvernement (ou les autorités responsables) doit intervenir pour organiser et canaliser

les courants d'information afin d'harmoniser au maximum les flux SQ et DQ.

2. Le modèle de planification

a. Hypothèses de travail

Il y a deux courants d'information qui quittent le marché de travail, l'un vers SDQ et l'autre vers DQ. Bien que d'une importance égale, ils sont d'une nature tout à fait différente. Si l'on intervient seulement sur le courant LM-SQ on soumet l'offre de qualifications aux exigences du marché de travail ou, en termes plus directs, l'éducation à la production. Le contraire se fait si l'on intervient seulement sur le courant LM-DQ, c-à-d on attache plus d'importance à l'éducation qu'à la production. Les deux positions sont extrêmes et donc à rejeter. Il faut plutôt analyser minutieusement le fonctionnement du marché de travail en considérant SQ et DQ comme des variables indépendantes l'une de l'autre afin de découvrir les causes possibles d'un mauvais fonctionnement de ce marché. Ce n'est qu'en agissant de la sorte qu'on évite des positions extrêmes et donc critiquables.

S'il y a effectivement mauvais fonctionnement et ayant découvert les causes, il importe donc d'intervenir. Ceci implique naturellement un jugement de valeur, car intervenir uniquement sur des courants d'information est beaucoup moins dirigiste qu'une intervention sur SQ et DQ elles-mêmes. En plus faut-il aussi décider de l'ampleur qu'une action possible doit prendre; doit-on adapter plutôt le système d'enseignement aux exigences de la production ou vice-versa? Le degré de dirigisme dans l'action est un choix que l'économiste théoréticien ne peut faire; il doit se borner à présenter les possibilités avec leurs implications. Par contre, il lui est impossible d'éviter complètement le deuxième choix, celui de l'ampleur de l'action. Ou bien il se met au point de vue de l'emploi maximal, voire complet, et il recherche les moyens d'adapter l'offre de qualifications, c-à-d l'enseignement, aux exigences du marché du travail. Ou bien il accepte la thèse de l'efficience maximale de la production de biens, et il essaie d'adapter la demande de qualifications à la situation de fait en matière d'offre.

Le présent modèle est fondé sur le premier jugement de valeur. Il essaie de fournir une réponse à la question fondamentale suivante: comment faut-il organiser l'enseignement pour donner un maximum de chances d'emploi aux diplômés? En d'autres termes: comment planifier l'enseignement pour que celui-ci réponde le mieux possible aux exigences du marché du travail? Bien que posé en des termes assez extrêmes, il n'est pas dans notre intention de développer un modèle qui soumet complètement l'enseignement qui lui convient au marché du travail. Il faut tenir compte de la liberté fondamentale de chaque individu de choisir telle forme d'enseignement qui lui convient le mieux, tout en essayant de canaliser ces choix vers ce qui est désirable du point de vue économique. C'est précisément ce dernier point de vue qui constitue le vrai jugement de valeur adopté ici.

A côté de cette position de principe, il y a encore un certain nombre d'hypothèses de travail purement techniques qu'il convient d'énumérer ici, sans toutefois s'y attarder longuement, car elles relèvent en majeure partie de considérations théoriques en matière de construction de modèles économiques. Nous citons:

1. Le modèle est construit sur la condition "ceteris paribus".
2. Le capital et la technologie sont des variables exogènes, ce qui n'implique pas qu'ils soient invariables.
3. Le modèle est exprimé en termes réels, c-à-d que les effets de prix ne sont pas pris directement en considération.
4. Il n'y a pas de changement dans la distribution des revenus.
5. Il n'y a pas d'effets de toile d'araignée (cobweb).
6. C'est un modèle conçu pour une planification à moyen terme (5 ans), ce qui atténue les effets des l'hypothèses 3,4 et 5.
7. Tous ceux qui étudient le font dans le but de se présenter sur le marché du travail, ou PQ=SQ (Figure 1).
8. Seules les différentes formes d'enseignement formel seront considérées.

b. Modèle de base

Dans la littérature économique il y a deux types de modèles de planification de l'enseignement, mieux connus sous leurs dénominations anglaises: d'une part les modèles du type Manpower Requirements Approach (MRA) et de l'autre ceux du type Social Demand Approach (SDA). Les modèles MRA ont été élaborés par H.S.Parnes et l'OECD (1). Ils se fondent sur des prévisions économétriques du Produit National Brut, ventilés par secteur de production. Sur la base de ces chiffres on calcule les besoins futurs en force de travail en tenant compte de l'évolution probable de la productivité dans chaque secteur. Ces résultats servent alors comme objectifs à atteindre par l'enseignement. Cette approche est purement mécanique et tient compte uniquement du côté demande du marché du travail.

Les modèles SDA partent plutôt de l'idée que l'éducation est un droit fondamental de chaque individu. Cette idée a été propagée par le Robbins Committee On Higher Education et le sociologue Allemand R.Dahrendorf (2). Ils prennent comme point de départ des prévisions concernant l'évolution du nombre des diplômés et posent alors comme principe que les employeurs n'ont qu'à tenir compte de cette situation de fait. C'est accentuer uniquement le côté offre du marché du travail. Combiner les deux approches dans un modèle global est le but de la présente contribution.

Pour atteindre ce but, nous allons d'abord construire un cadre de référence théorique dans lequel l'offre aussi bien que la demande de qualifications ont la signification qui leur incombe. L'instrument d'analyse utilisé à cette fin est la technique des isoquants, bien connu par les économistes. Supposons que dans un système économique hypothétique le PNB puisse être obtenu en utilisant uniquement deux types de travail, notamment celui avec la qualification a ainsi que celui avec qualification b. Ces deux types de qualification sont interchangeables, de façon à ce que le même niveau du PNB puisse être obtenu en utilisant un certain nombre de combinaisons de a et b.

Acceptons pour l'instant que l'actuel PNB est obtenu en utilisant la combinaison (d_{a0}, d_{b0}); c-à-d qu'on a besoin de d_{a0} de travailleurs avec la qualification a et de d_{b0} avec la qualification b (Figure 2, premier quadrant). Le point D_0 est donc l'emploi qui correspond au niveau actuel du PNB. Une prévision du PNB pour l'année t nous donne par exemple le point D_t, ce qui signifie que la combinaison (d_{at}, d_{bt}) représente la structure de l'emploi au moment t. L'évolution de la demande de qualifications suivra donc la voie d'expansion D_0D_t. Ceci pourrait être intitulé comme le côté MRA du modèle de planification.

Le deuxième volet du modèle se tourne vers l'offre de qualifications. En revenant au point D_0, il n'y a a priori aucune raison pour conclure que la combinaison (d_{at}, d_{bt}) en est une de plein emploi. Au contraire, la situation de crise économique des années septante et quatre-vingt nous montre qu'il est très réaliste de partir d'une situation de sous-emploi. Supposons s_{a0} et s_{b0} comme offre totale actuelle des qualifications a et b. Il s'en suit que la combinaison (s_{a0}, s_{b0}) représente le plein emploi et le point S_0 est le niveau du PNB actuel qui pourrait être réalisé dans cette situation de plein emploi.

En supposant $s_{a0}>d_{a0}$ nous obtenons:

$$W_{a0}= s_{a0} - d_{a0} \qquad (1.1)$$

avec: W_{a0} = sous-emploi de la qualification a.

La logique économique nous oblige à accepter que $W_{a0}=0$ si $s_{a0}<d_{a0}$.

De façon analogue nous obtenons dans le cas $s_{b0}>d_{b0}$:

$$W_{b0} = s_{b0} - d_{b0} \qquad (1.2)$$

avec: $W_{b0} = 0$ si $s_{b0}<d_{b0}$.

En conclusion nous obtenons:

$$W_0 = W_{a0} + W_{b0} \qquad (1.3)$$

comme sous-emploi total initial.

Une prévision de l'offre totale de qualifications au moment t - en absence de toute intervention planificatrice - nous donne une combinaison (s_{at}, s_{bt}), ce qui correspond au point s_t. Analogue à ce qui précède nous pouvons poser:

$$W_{at} = s_{at}-d_{at} \qquad (s_{at}>d_{at}) \qquad (1.4)$$
$$W_{at} = 0 \qquad (s_{at}<d_{at})$$

$$W_{bt} =s_{bt}-d_{bt} \qquad (s_{bt}>d_{bt}) \qquad (1.5)$$
$$W_{bt} = 0 \qquad (s_{bt}<d_{bt})$$

Ce qui donne:

$$W_t = W_{at} +W_{bt} \qquad (1.6)$$

Tout cela ne nous donne aucune indication concernant la relation entre W_0 et W_t, c-à-d qu'a priori tous les cas restent possibles ($W_0>W_t$; $W_0=W_t$; $W_0<W_t$). La seule conclusion légitime est que l'offre de qualifications suivra la voie d'expansion s_0s_t. Ceci représente le côté SDA du modèle de planification.

Le troisième volet devra forcément confronter les deux précédents, afin de parvenir à une voie d'expansion réaliste de l'enseignement compte tenu des évolutions probables de l'offre $(s_0 s_t)$ et de la demande $(d_0 d_t)$ de qualifications. La détermination de cette voie d'expansion et des instruments politiques pour la réaliser dépendent naturellement de l'objectif qu'on se pose. Ceci est clairement un choix normatif qui - comme nous l'avons déjà expliqué plus haut - dans le présent modèle est exprimé en termes d'emploi, avec la restriction toutefois qu'il s'agit d'atteindre un niveau d'emploi optimal (réaliste) et non le plein emploi (moins réaliste). Cela veut dire que l'objectif à atteindre est la combinaison (d_{at}, d_{bt}) ou le point D_t.

Pour déterminer concrètement une voie d'expansion qui tient compte de l'objectif posé, il faut nécessairement aussi prendre en considération le niveau existant de sous-emploi. Cela signifie que la voie d'expansion doit partir du point S_0 (et non D_0), ce qui nous mène à la voie SD_t. Le point S_t devra maintenant être déterminé en fonction de cette voie d'expansion.

Sans intervention le système d'enseignement délivrera la combinaison (s_{at}, s_{bt}) dans l'année t. Dans la mesure où il y aura divergence entre (s_{at}, s_{bt}) et (d_{at}, d_{bt}) une situation de sous-emploi sera maintenue, ce qui est illustré dans la figure 2.

L'évolution séparée de l'offre et de la demande de la qualification b est reprise dans le quadrant II et celle de la qualification a dans le quadrant IV. Il en résulte que pour la qualification a on verra se développer dans la période considérée des tensions sur le marché du travail, puisque l'offre et la demande se croisent à un certain moment. Ce n'est par contre pas le cas pour la qualification b. Sans intervention, la situation globale sur le marché du travail évoluera donc vers R_t et non D_t, ce qui est clairement suboptimal. Il n'y a non seulement un excédent d'offre (et donc sous-emploi) dans la qualification b, mais en même temps un excédent de demande de la qualification b.

Il est clair que cette situation n'est pas unique; ce n'est qu'une des multiples situations possibles. Mais elle démontre néanmoins qu'une intervention active en matière de politique d'enseignement peut s'avérer nécessaire afin d'éviter des distortions du marché du travail, ou tout au moins d'en minimiser les effets. Il se peut que D_t ne puisse être atteint, mais il faut néanmoins s'en approcher le plus près possible.

c. élaboration du modèle

L'objectif à atteindre est donc un niveau d'emploi optimal en tenant compte séparément de l'évolution de l'offre et de la demande de qualifications. Ceci peut se faire de différentes manières, suivant les critères d'optimalité qui sont acceptés. Graphiquement ceci peut être illustré par la Figure 3. Sans toucher à la signification du graphique, nous avons déplacé l'origine (Figure 2, quadrant I) vers le point D_0, qui du reste maintient aussi sa signification. L'axe horizontal représente maintenant la quantité de qualification a supérieure à d_{a0}, et l'axe vertical la quantité de b supérieure à d_{a0}. Puisque toutes ces quantités seront exprimées par rapport à l'année de référence t, nous éliminerons pour des raisons de simplicité d'expression les indices t dans les symboles employés.

La ligne (AB) est l'isoquant de l'offre additionnelle de qualifications a et b dans l'année t. Cela veut dire que (AB) représente toutes les combinaisons possibles de a et de b que le système d'enseignement peut fournir en l'année t. Si l'on définit:

$$s=s_a + s_b \qquad (1.7)$$

on a en même temps l'équation de la ligne (AB). Le point A a donc comme coordonnées (s,0) et le point B (0,s).

Un des critères essentiels d'optimalité est la condition qu'il ne peut y avoir des tensions sur le marché du travail; ce qui équivaut à la condition:

$$\begin{array}{l} s_a > d_a \\ s_b > d_b \end{array} \qquad (1.8)$$

Le point S_t, qui finalement est l'objectif à atteindre, se situera donc dans le segment (A'B'). Ceci nous donne un assez grand degré de liberté d'action, puisque toutes les combinaisons de a et de b qui correspondent à un point de (A'B') entrent en compte comme objectif d'une intervention dans l'enseignement. Si par contre nous voulons pousser l'analyse encore plus loin en essayant de déterminer exactement l'emplacement de S_t sur (AB), nous sommes obligés de poser encore d'autres critères en surplus.

Acceptons par exemple la condition que l'emploi (ou le sous-emploi) doit être réparti proportionnellement sur toutes les qualifications, ou en d'autres termes: l'offre de qualifications doit être proportionnelle à sa demande. En termes formels:

$$\frac{s_a}{da} = \frac{s_b}{d_b} \tag{1.9}$$

avec comme condition subsidiaire:

$$s = s_a + s_b \tag{1.7}$$

Cela nous donne comme solutions:

$$s_a = \frac{d_a}{d_a + d_b} s \tag{1.10}$$

$$s_b = \frac{d_b}{d_a + d_b} s \tag{1.11}$$

Le point S_t avec coordonnées (s_a, s_b) se trouvera donc sur l'intersection de l'isoquant (AB) et de la ligne D_0D_t. Cette solution correspond au point C sur le graphique. Il est clair que cette solution n'est pas acceptable dans le cas où D_t se trouve à droite de (AB). Il faut alors augmenter proportionnellement l'offre de a et de b jusqu'au moment où C coincide avec D_t (Figure 4).

Il y a de fortes raisons de douter de la valeur réaliste de ce critère de proportionnalité. C'est pourquoi nous préférons poser un autre critère qui rejoint beaucoup plus les idées de base sur lesquelles le présent modèle est conçu. Il s'agit du respect à apporter à la liberté du choix individuel en matière d'éducation. Nous posons donc comme critère que toute planification de l'enseignement doit tenir compte au maximum de l'évolution autonome de l'offre des qualifications. Si la solution pour s_t, c-à-d le point C (Figure 3), appartient à (A'B') il n'y a clairement aucun besoin d'intervention. Par contre, si C appartient à (BB') l'unique point optimal est B'. En effet, les coordonnées de B' sont (d_a, d_b), ce qui signifie qu'il n'y a pas de chômeurs avec la qualification a.

Finalement, si C appartient à (AA') la solution optimale est A', puisque il n'y a pas de chômeurs avec la qualification b. Toute action de planification devra donc avoir comme objectif de produire une combinaison de a et de b qui soit le plus près possible de (A'B').

Il est certainement utile d'envisager encore d'autres critères qui mettent en valeur les aspects plus économiques de l'enseignement, comme par exemple la minimisation de coûts de l'enseignement. Mais cela nécessite l'emploi d'instruments d'analyse économique assez poussés, ce qui n'entre pas spécifiquement dans la thématique du présent congres.

3. L'influence de la technologie

Comme il a été indiqué plus haut, le point D_0 (Figure 2) est à considérer comme faisant parti de l'isoquant qui exprime le niveau atteint du PNB en fonction des qualifications a et b employées à cet effet. Il en va de même pour D_t. Ce que nous ne savons pas par contre c'est la forme de ces isoquants. Cela résulte du fait que le modèle ne précise rien en ce qui concerne la substituabilité entre a et b. Est-il ainsi que le PNB ne peut être réalisé qu'avec la combinaison (d_{a0},d_{b0}) ou est-ce qu'il y a encore d'autres combinaisons possibles? La même remarque vaut aussi pour (d_{at},d_{bt}).

Il y a deux cas extrêmes possibles à cet égard. Tout d'abord celui des coéfficients fixes d'input, ce qui signifie que (d_{a0},d_{b0}) est la seule combinaison possible. Les qualifications a et b ne sont donc pas substituables et D_0 est le point d'angle d'un isoquant continu et non-différentiable du type Leontief (Figure 5). Faire une prévision concernant D_t ou la combinaison (d_{at},d_{bt}) est donc plus simple puisque D_t doit se trouver sur le prolongement de la ligne $0D_0$ à cause des coefficients fixes d'input.

Dans l'autre cas extrême on suppose les qualifications a et b parfaitement substituables. Le niveau PNB_0 peut donc être réalisé en utilisant toutes les combinaisons possibles situées entre $(d_{a0},0)$ et $(0,d_{b0})$. Tous les points D_0 appartiennent à un isoquant continu et différentiable du type Classique (Figure 6). Une prévision de D_t sera très difficile vu qu'ici aussi toutes les combinaisons entre $(d_{at},0)$ et $(0,d_{bt})$ seront possibles.

Il est vrai que ces deux cas extrêmes sont peu réalistes, car les qualifications possèdent un certain degré de flexibilité dans leur emploi dans la production (3). Il faudra donc faire appel à la mèthodologie de l'analyse d'activité, qui part de la constatation qu'un certain niveau de production peut être obtenu par un nombre limité de combinaisons de facteurs de production, sans que ces derniers soient parfaitement substituables (4). Supposons - en guise d'exemple - que PNB_0 peut être réalisé par quatre combinaisons différentes de a et de b, notamment D_{01}, D_{02}, D_{03}et D_{04}. Ces quatre points forment donc l'isoquant continu et non-differentiable PNB_0 (Figure 7).

De quelle façon l'hypothèse d'une technologie non-constante influence-t-elle le modèle de planification développé dans le paragraphe précédent? En reprenant la Figure 2 (quadrant I) il est clair que dans ce cas ni D_0 ni S_0 changent, puisque, il s'agit de valeurs actuelles existantes. Le point S_t par contre est le résultat d'une prévision, mais il nous paraît raisonnable de l'accepter en tant que tel, au moins dans la période mi-longue, vu la durée des études et l'inertie de l'enseignement. Il n'en est pas de même pour le point D_t, c-à-d la prévision de la demande de qualifications. Il n'y a a priori aucune raison de croire qu'il soit unique. Vu la possibilité de substitution, plusieurs combinaisons de a et de b sont possibles, ce qui implique que nous devons considérer l'isoquant PNB_t entièrement. Mais il est difficile de prévoir quantitativement l'évolution de la technique, ce qui signifie que PNB_t est difficilement à détèrminer à l'aide de méthodes quantitatives. Il faudra recourir à d'autres méthodes qui relèvent plutôt de l'enquête directe chez les entreprises.

Supposons que dans l'année t il y ait cinq combinaisons possibles, notamment: D_{t1},D_{t2},D_{t3},D_{t4} et D_{t5} (Figure 8). Compte tenu de la prévision de l'offre (S_t) il n'y en a que trois qui entrent en ligne de compte, notamment: D_{t2},D_{t3},D_{t4}. Il y a donc trois voies d'expansion possibles pour l'enseignement, à savoir: S_0D_{t2},S_0D_{t3} et S_0D_{t4}. Pour chacune d'elles les calculs du modèle peuvent être faits. Des trois solutions obtenues, il faut choisir celle où l'emploi est maximal, ce qui signifie que $d_a + d_b$ doit être maximal.

Il s'ensuit que le modèle est applicable aussi dans le cas d'une technologie non-constante, ce qui après tout est l'hypothèse la plus réaliste. La seule grande difficulté réside dans la détermination de l'isoquant PNB_t. Le seul moyen d'y parvenir est d'enquêter concrètement chez les employeurs pour connaître leurs prévisions de l'avenir en la matière, bien qu'il faut reconnaître qu'une telle entreprise est longue, coûteuse et mène parfois à des résultats assez aléatoires.

4. Conclusion

Le modèle présenté ici est purement théorique. Il n'est présenté, pour des raisons de simplicité, que dans une version bidimensionnelle, c-à-d qu'il ne tient compte que de deux qualifications. En l'appliquant à des données empiriques il peut facilement être élargi à n dimensions. Une telle application est en cours pour la Flandre et vise une période de cinq années, ce qui veut dire que t = 1990.

Il est important de noter aussi que le modèle ne contient aucune recommandation concernant les instruments de planification. La forme que doit revêtir une intervention dans le secteur de l'éducation dépend d'un certain nombre d'autres jugements de valeur qui n'entrent pas dans le cadre de la présente étude. Nous estimons d'ailleurs que dans ce domaine-là, il n'y a que l'économiste qui a son mot à dire.

Notes

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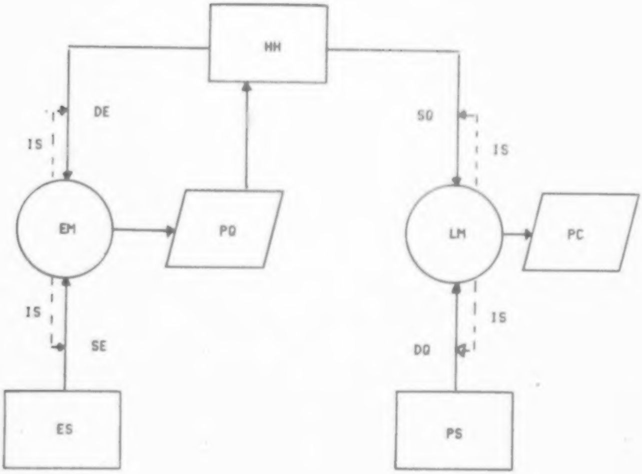

Fig. 1

HH = ménages
DE = demande d'enseignement
SE = offre d'enseignement
EM = marché de l'enseignement
ES = système d'enseignement
PQ = production de qualifications
LM = marché du travail
PS = secteurs de production
PC = production de biens
SQ = offre de qualifications = demande de travail
DQ = demande de qualifications = offre de travail
IS = courant d'information

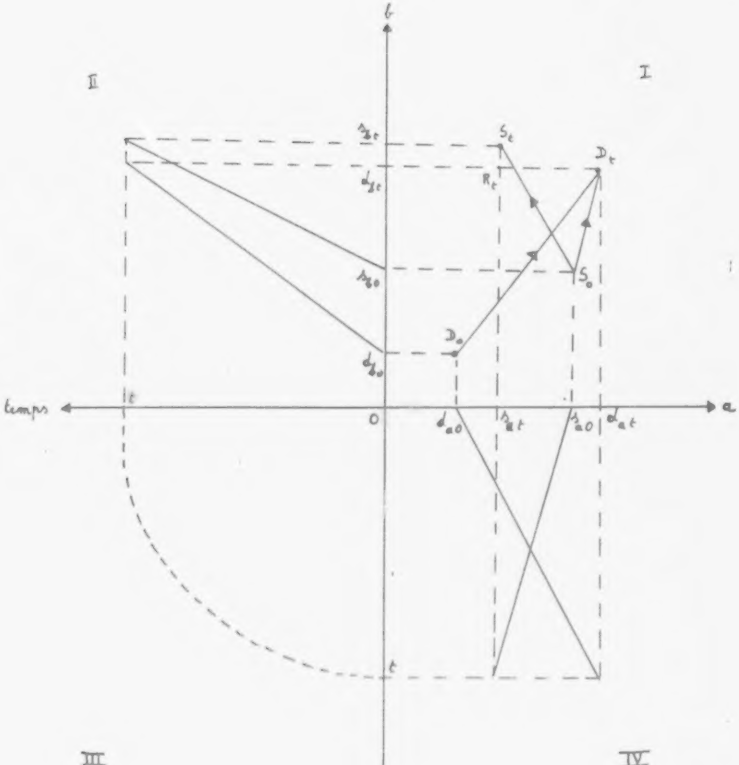
b
II
I
s_{bt}
S_t
D_t
d_{bt}
R_t
s_{b0}
S_0
D_0
d_{b0}
temps
t
0
d_{a0}
s_{at}
s_{a0}
d_{at}
a
t
III
IV
temps

Fig. 2

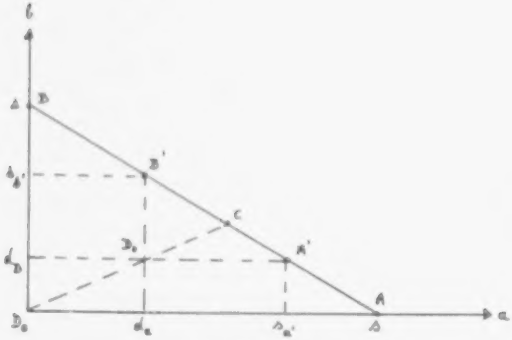
b
s
B
B'
s_b'
C
D_c
d_b
A'
A
D_0
d_a
s_a'
s
a

Fig. 3

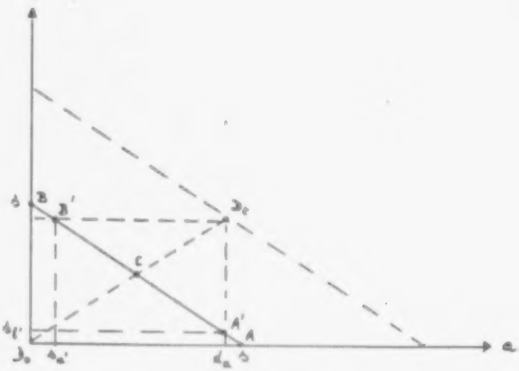
b
s
B
B'
D_c
C
s_b'
A'
A
D_0
s_a'
d_a
s
a

Fig. 4

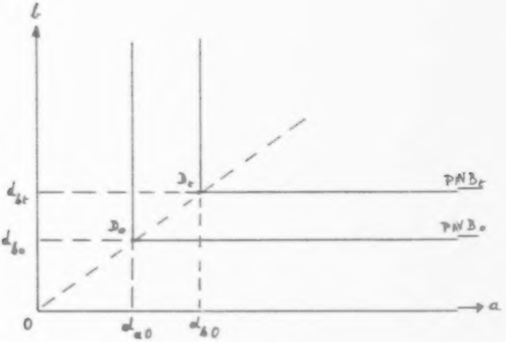
b
d_{bt}
d_{b0}
D_t
D_0
PNB_t
PNB_0
0
d_{a0}
d_{b0}
a

Fig. 5

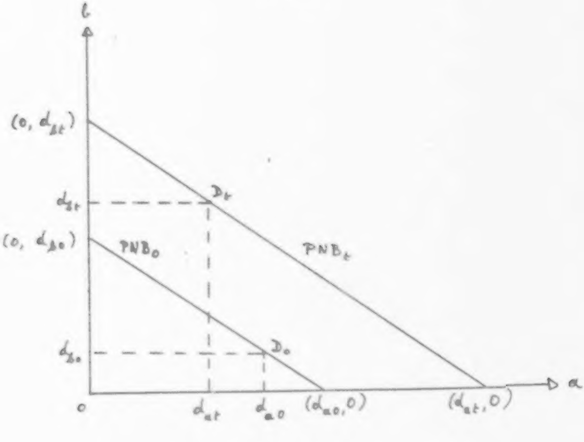
b
$(0, d_{bt})$
d_{bt}
D_t
$(0, d_{b0})$
PNB_0
PNB_t
d_{b0}
D_0
0
d_{at}
d_{a0}
$(d_{a0}, 0)$
$(d_{at}, 0)$
a

Fig. 6

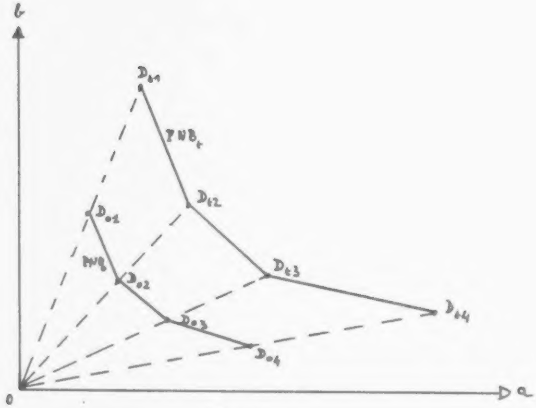
b
D_{t1}
PNB_t
D_{t2}
D_{o1}
PNB
D_{o2}
D_{t3}
D_{t4}
D_{o3}
D_{o4}
0
a

Fig. 7

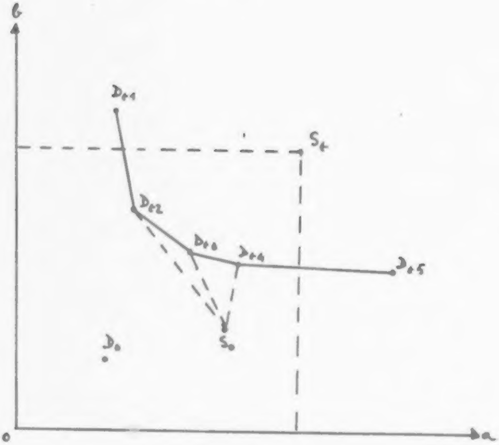
b
D_{t1}
S_t
D_{t2}
D_{t3}
D_{t4}
D_{t5}
S_o
D_o
0
a

Fig. 8

DEVELOPMENT, TECHNOLOGY AND EDUCATION - INDIAN PERSPECTIVE

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Introduction

Human society displays sharp and dangerous contradictions. One third of humanity is on the pursuit of pleasure, often at the cost of reckless exploitation of the resources, irreversible degradation of the environment and even a threat to the survival of humanity through an arms race. The other part has yet to break the bonds of poverty and obtain the basic necessities of life. Of course, there are internal disparities between the two worlds, with islands of poverty and wealth in both, and there are shades of rich and poor countries, but the vast majority have yet to take off.

The underdeveloped countries, which are basically excolonies or countries dominated in the past by the developed countries, got a lease of life when they achieved political freedom after World War II. In the euphoria of freedom, development was often simplistically and optimistically viewed in the image of the western world and considered to be easily realizable through science and technology. Modernization was often identified with industrialization and a "trickle down" strategy based on importation of capital-intensive technology from industrialized countries was often adopted, as in the case of India. Although no doubt substantial progress has been made, such as a remarkable indigenous scientific and technological capabililty and extension of education, the results of more than a quarter of a century, however, show no signs of effective repression of poverty and generation of employment. For instance, 40 per cent of the population live below the poverty line. The socio-economic state, despite some impressive gains in terms of technological achievements, does not display dynamism and commitment of the people. A concerted war has to be waged on poverty and backwardness. Technology and education are indeed the key instruments in this context but certain basic policy issues about developments, technology and education and their social interrelation are most important. While much of our discussion may be relevant for the less developed countries, the implementation will differ from one country to another in view of their initial and boundary conditions. Ours is the Indian perspective.

Development

Without going into the semantics of the terminology of modernization and development, the central point is that it is a process of directed societal change. It is basically a normative concept, almost a synonym for improvement. There have been cumulative and revolutionary changes in various parts of the world at different times. The modern revolution is a unique phenomenon started in the western societies after the middle ages and has shown remarkable dynamism in all facets of the societal system political, cultural, economic and social. It was often violent and even retrograde but cumulatively it led to the ascent and the dominance of the western world. At different periods, the development has been characterized as Renaissance, Reformation, Enlightment and later the Industrial Revolution which led to a quantum jump in social change which is still going on and has even lead to another phase termed the post-industrial society. Accelerated change, of which science and technology are the principal instruments, is an essential characteristic of modern society. It shapes institutions values and attitudes and in turn is as much shaped by them. The central fact is that the social system of the advanced western countries has developed synergetic, endogenous, organic dynamism and creativity on the whole, shaped over time. Modern technology and the educational system are its historical subsets.

Underdevelopment, euphemistically labelled in various terms, is closely associated with the development of the western world. There have been disparities in wealth among countries and people, subjugations and dominations in history, but with the rise to power of the industrialised world, there was a much higher capability of exploitation, which was exercised ruthlessly through colonisation and other political and economic means. Social fabric of these countries was torn asunder and the entire social change was in the context of exploitation. The society consisted of rulers and the ruled. Psychological attitudes of servility, self-denigration and dependency developed in these people and were reinforced. Social mobility of the natives was possible through subordinate association with the foreign masters and the native elites distanced themselves from the people. Education itself became an instrument of social cleavage. All activities depending on the government and private entrepreneurship ceased. The bureacracy was not for civil governance as in the west but for extending the grip for the consolidation of power and a corresponding culture of colonial bureaucratic institutions developed (8). The technological activity was for the maintenance of law and order and was minimal, such as for the construction of a few roads, houses for the colonial masters and their local native allies and a few railways for administrative requirements. Almost eighty percent of the population lived in villages in increasingly worsening conditions as their traditional industry lost to the modern imported goods. Industrialisation of the colonies was prevented deliberately to use the raw materials and resources for the growth of industry and economy in the metropolitan societies. Thus while in the developed world there were cumulative causative processes of self-reliant dynamism, socio-political integration with resultant structural changes, institutions and attitudes, there was in the developing countries a corresponding process of dominance, disarticulation and poverty (9). Domination implies that the underdeveloped country does not have a capacity for autonomous decision-making and that it exercises little control over its destiny, thus being in an extreme form of dependence. The primary form of dominance is political and economic, although it is closely related to cultural and technical domination, with one of them leading to or implying the other. Disarticulation means that the underdeveloped country does not constitute a homogeneous unit from the cultural, social and economic point of view. It is a highly stratified society with little or no interaction among the various strata. There is a comparatively high-income group alienated from the rest of the society which tries to adopt the values and life style of the colonial masters.

After independence, although self reliance has been the central theme, and although considerable material progress has taken place, the spirit of national commitment and independence in values and attitudes is increasingly eroding and the spirit of independence recedes into the past. Correspondingly, disarticulation is also increasing. Increasingly, the elite urban group tries to ape the life style and consumerist trappings of the western world, creating a dual society, a parallel culture, which exacerbates further stratification and fragmentation of society.

Indeed, in the modern world of shrinking time and space, with modern technology and increasing power and prosperity of the developed countries, the underdeveloped countries face a new threat, a phenomenon which has distorted the entire developmental process. Linkages in the two worlds increase with increasing knowledge, technology, trade and a better international communication system. First, the involuntary impact of the outside world on a developing nation through radio, TV, books, magazines, consumer goods creates not only unattainable expectations, attitudes, and life styles that are totally unrelated to the developing nation's own situation, but worse, they threaten to overwhelm and stifle indigenous cultural creativity. Second, with the increasing imbalance in power and prosperity of the two groups, technology and education are emerging as significant and forceful instruments for maintaining an existing dominance/dependence relation in the international economic and political system. ("Policy leverage" is the polite phrase used in policy documents of such countries). There is an increasing tendency of vested elite groups to gravitate towards their counterparts in the developed world, as they did towards the colonial masters with increasing dependency and disarticulation of their country. The erstwhile colonial powers and the superpowers may not be directly responsible for continued colonial systems, but they derive economic and political gains from them and naturally tend to encourage and exploit the situation, explicitly and implicitly, perpetuating in more subtle forms the peripherality of the less developed nations.

Technology

Science and technology have been considered to be the main instruments of development in the western world (10). Technology has also been considered to be the primary instrument of development of the underdeveloped world (11). Concepts of technology, developmental policy and technology policy have, however, been varied and often vague.

The political decision makers have often considered technology as a set of capital and consumer goods that are currently on display in the western industrialised nations. Technologists and economic planners have generally identified technology with hardware of production - knowledge about machines and processes. Two assumptions are implicitly made about technology: first, that it is an isolated technological activity to be decided by technological feasibility and efficiency considerations independent of socio-economic considerations. Very often, it is thus visualised in the image of the sophisticated complex modern technology of the west. Second, the technology is neutral with respect to class and country and factor use and any distortions in development patterns resulting from the use of technology must be attributed to misuse rather than to the nature of technology (12). Institutionally, its application in the developing countries is determined by bureaucratic - technological decisions in the infrastructure area and private - profit cost benefit analysis in the private sector area. The demand component is thus determined by the colonial bureaucracy and elitist sector of society and not by the masses. For instance, despite an easily soluble problem of the supply of drinking water, food supply, simple houses, electricity, mass transportation and other basic needs, elitist consumer goods are often produced and public sector activities are undertaken inefficiently and that, too, without concern for the needs of the masses.

Discussions have taken place about inappropriate western technology distorting the pattern of developing following a particular lop-sided pattern of growth, creating employment problems and skewed income distribution and failing to make use of poor countries natural and human resources. Use of appropriate technology has been suggested. However, often it is an expression of wish rather than a policy. Technology has a wider connotation than mere hardware of production. It includes all the skills, knowledge and procedures for making, using and doing useful things. Technology thus includes methods used in non-marketed activities as well as marketed ones. It includes the nature and specification of what is produced as well as how it is produced. It encompasses managerial and marketing techniques as well as techniques directly involved in production. Technology extends to service-administration, education, banking, health services, housing, transportation, for example - as well as to manufacturing and agriculture. It pervades the total societal system, interacting with it dialectically.

Technology has demands on education, imposes requirements on mental processes and generates life patterns. Technology thus involves in each societal system, through adaptation and indigenous development in a historical cultural context. It depends on socio-political-economic institutions, and motivational mechanisms besides skills (12). In the industrial societies where most technical development has and is currently taking place, technological and educational social change form a positive interconnected and self-reinforcing dynamic cycle.

The technology has therefore to be indigenously developed or adapted for the development and needs of all sections with specific concern for the traditional sector and the poorer section. While the development of technology for the traditional sector has priority and urgency, modern technology is also required so that for a certain period there is a self-sustaining capacity for technological pluralism, but there must be arrangements for integrating the technologies into a coherent and self-reinforcing technological system at the national level (13). As has been noted, of paramount importance will be the need to develop the country's own potential to the fullest extent, promoting a process of endogenous development in which scientific and technological capabilities must play a leading role. It is essential to develop societal capacities and motivations to release and nurture the creative potential of the country's population, to support the appropriate institutions, to generate, interpret and utilise knowledge for development objectives, and to introduce the necessary social, economic, political, and national transformations that will make these tasks possible. Policy recommendations have been made for self-reliant development (14) but the initiative lies with the government and in appropriate development of the education sector.

Education

Development in the last analysis is the mobilisation of human resources for human benefit and education emerges as the most important activity in this context. Education has been called upon to endow people with that knowledge, that training, that orientation, that spirit of initiative and social responsibility that can enable them to do the job of development in the circumstances in which they live.

Indeed high hopes were laid on education in the wake of Independence by nationalist leaders. The exponential growth is indicative of the fact that it was implicit faith in education as an instrument for increasing economic productivity that brought about social transformation and social mobility. International experts also placed lot of faith in education as an instrument of development (15). Commissions were set up soon after independence and later education was examined comprehensively and integrally in 1966 to develop an articulated national system that could remove many of the anomalies of the colonial education which were distorting educational aspirations of an emerging independent society (16).

Primary education of five years was proposed to be universal by 1985-86. Policies were envisaged for improving the quality of education and reducing stagnation and wastage to a minimum. Secondary education was proposed to be revolutionised by siphoning off fifty percent to vocational courses. The accent was on gearing secondary education to life situations and social needs. Vocational training was suggested to be organised in part-time courses also at the lower secondary level, classes were to be organized by industrial and agricultural polytechnical schools leading to an engineer's diploma.

The university education was also to be profoundly changed. Six universities were to be selected as major universities, where postgraduate work and research of international standards was to be carried out. In addition, about fifty centres for advanced studies were to be established. For the remaining other universities also improvements of personnel, teaching materials, methods of evaluation were to be made. Admissions to universities were to be based on manpower requirements.

Unfortunately none of these revolutionary changes for appropriate education have been achieved. Illiteracy continues to be more than 60 percent, secondary education is oriented to university education, which itself continues to be unrelated to manpower requirements in terms of skills or to high standards and generally is conducive to unemployment. Since educational matters have become political questions, the colonial education has only expanded and not changed. Most educational investments enhance the power of those who already have political advantages and deprive those who suffer inequities and lack opportunities (17). These are attributes of the development pattern itself. It is difficult or even impossible to discuss serious changes in an inherent class reproducing educational system - the manner in which education expands, which levels are favoured for expansion, the nature of the curriculum and the value attached to each level of schooling-without structural reforms in production relations and their underlying power relations. Thus, disparities widen and reinforce inequities of the social structure and unless radical political and social transformation takes place, the educational system will continue to accentuate traditional power patterns of the developed societies.

Technology, Education and Society

Technology has a profound bearing on all institutions society-economic, political, and educational. But, the direction of the technological impact depends upon societal values, no doubt with dialectical interaction. For developing societies, in which technology has not as yet acquired an overriding independent momentum, it may be well to take a second look into technology, education, social dynamics so that a proper direction may be obtained to the planned social change.

Education formed part of religious teaching historically, but even when religion started losing its hold with the separation of state and church in the west, and with colonization in the less developed countries, moral values and ethical concepts, both for the individual and for society, remained important aspects of education. The accent on humanism and liberal education were considered basic to the development of character and culture but with technology and growing mechanization, the human factor has been overshadowed, splitting modern education into two heterogeneous worlds, an "active content", embodying a scientific spirit and a "humanist" culture, which is not acknowledged to have any practical value.

Technology has contributed to increased productivity, and higher standards of living but the vehicle of technology has been private profit. It has, therefore, caused a loss of social and environmental concern. With the development of technology the demand is more for communication of information and for development of skills rather than for development of norms and social ethos. The two are not antithetical, but somehow, science and humanistic studies, have almost developed two mutually irreconciable different cultures. Technical education has suffered even more in terms of the humanistic component of education as, often, it was even kept out of the traditional higher education system.

The technological impact has put serious strains on society and educational systems as the latter are conservative and slow to adjust. On the other hand rapid and persuasive changes are brought about by technology at an ever increasing rate. The question, therefore, arises whether norms and values must necessarily be discarded to modernise educational systems and for enhancing the developmental process. The problems of urban life and environmental degradation are manifestations of this dilemma.

The problems arise in an even more serious form for the developing countries as the time dimension of change is far more important and regulatory mechanisms are even less developed. Further, where tradition is still adhered to, the basic problem is if an uncritical adoption of technology - but value-free-education - will lead to a good life. As it is, constant exposure to the import of western ideas, through books, and exposure to visual media, are impinging on the thought process, behaviour and attitudes which represent a total break from the accepted social mores and indigenous philosophy of life.

The experience in India has not been entirely satisfactory. The import of education in the colonial context led not only to erosion of values but to the disruption of society itself. The process is being exacerbated with the skepticism and alienation of those who are exposed and succumb to its glitter.

The legitimate question is if one can go on as of now with action and percepts at variance with each other, hoping that enough material satisfaction shall be obtained by all to keep disarticulation checked, or that the system will unwind itself till the poor and unemployed cannot live on hope and embark on violent upheavals with disruption of the past? While the former was the course of history for the currently developed world, the latter path has also been followed in other societies.

An alternative development policy was enunciated by Mahatma Gandhi, in which concept of development was central in the fight for independence. Development was considered as the mobilization of a hitherto stagnant social system through socio-cultural resurgence, development of moral values and sense of service. It emphasized creativity and self-reliance which required first and foremost generating a sense of natural and cultural identity with the self-esteem and pride that go with it. It was considered that the community's identity, cultural integrity and meaningful systems are themselves the matrix out of which emerge the goals of authentic development for that community. Development must transcend the concept of material wellbeing in terms of a broader purpose of life as crystallised in the traditional culture of the nation, so that the impulse for change, creative adjustment and innovation is continuous and self-sustaining. The elites were to develop identification with the masses through austerity and social service to inhibit disarticulation. Education was to emphasize values and character besides skills.

Development could not therefore be in terms of a trickle down of material benefits, but a war had to be declared for the eradication of social injustices and poverty. Education and technology were to have priority for redressing ignorance and abysmal poverty. Technology, traditional and modern, and education, basic or advanced, were there first and foremost to humanise, meet the basic needs and redress the social and economic inequities which had enmeshed the social system over centuries of exploitation. Development was not the mere acquisition of the trappings of western education and technology. It meant the discovery of India and the advancement of culture and values through education and technology, which were to be developed indigenously.

Conclusion

Technology and education have not served the development process well so far. The benefits have not reached the masses and very often violent radical political transformations have taken place. Democratic norms have often been replaced by different ideologies and systems have emerged where masses continue to suffer. Technology and education are being exploited by the elites who through rear guard action have managed to preserve their power and wealth in collaboration with foreign interests. Technology may have mitigated much of drudgery, but in societies with subsistance economies, one cannot expect to encourage consumerism, which only touches the fringe of society. An alternative approach was followed in India. It embarked on a socialist democracy under the enlightened leadership of Gandhi and Nehru. It was not self-interest but service of the masses which formed the basis of this approach. The policy, unfortunately, got distorted and the calculus of modern capitalistic technology and education took over the command. The achievements so far have not put society unmistakably on a self-sustaining path of non-violent development. Increasing materialism has its own hazards, and technological advancement its own abuses. Thus, the need is for the emergence of a new culture, a civilization that not only places faith in exponential growth and affluence but dignified work and self-reliance, spirituality, and contentment.

Notes

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THE INTERACTION BETWEEN TECHNOLOGICAL DEVELOPMENT, SOCIETAL CHANGE AND EDUCATION - AUSTRALIA, A CASE STUDY

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The substantial emphasis in this paper is on changes at three levels of education in response to, and interrelated with, Australia's pattern of industrial expansion, societal pressures and technological development over forty years since World War II.

This paper reviews and attempts to interpret the interlocking factors in this pattern of expansion. The composition of the population of Australia changed through successive waves, first of European and later of Asian immigrants. This gave the nation an injection of technological skills basic to a developing economy. During the 1960s and 1970s significant mineral discoveries provided a new dimension to traditional primary production centred on wheat and wool. The strength of investment from overseas and the recent sophistication of commercial enterprises mirror an exciting economy.

Embedded in this pattern of technological and societal transformation is a range of educational systems, State-based, which are broadly responsive to the nation's changing needs and are developing flexibility in meeting these. This paper reviews three distinctive levels across the educational spectrum and traces the extent to which each is supportive of and interacts with the nation's industrial and commercial sectors.

When the industrialization of Australia began more than a century ago it was within the context of an agricultural economy. The important gold mining discoveries of the 1850s led to a dramatic rise in the immigrant population, substantially from the British Isles. This gave a stimulus to manufacture and to mining for other metals. It was accompanied by steady growth in agriculture to sustain the new colonies. The 1880s were a period of boom built around public work, land speculation and further mineral discoveries. Into the new century a further impetus was given through the establishment of steel works and related manufacturing. From this point to the years of prosperity, 1920-1929, manufacturing production expanded by 40 per cent. As Australia moved out of the Great Depression manufacturing industries responded to government stimulation and tariff protection, thereby providing a launching pad for further industrial expansion. Factory employment increased by 30 per cent in this period. Wartime experience in engineering showed the great potential for Australian industrialization. It became the basis for subsequent production of capital equipment as well as consumer durable goods.

During World War II Australia became for the Allies not only a food arsenal but also a significant contributor to the technology of war. Australians learned that technologies and technical change are not autonomous, nor are they in a vacuum. Rather, they are produced within a social, economic and cultural context.

This was most evident in the highly successful Commonwealth Reconstruction Training Scheme (CRTS). Through this scheme thousands of ex-service men and women received government funded preparation for re-entry to the work force. The peacetime perceptions and career aspirations of many were strengthened through courses in technical colleges, institutes of technology and universities. Although technical colleges received a tremendous financial fillip from CRTS, the main effect was on the rigidity of trade courses within them. The more mature trainees, as new entrants to industry, found stereotyped courses in trade theory and trade practice insufficient to satisfy their needs. Those, however, who were able to embark upon higher level technology courses, either for a degree from a university or a diploma from an institute of technology, reacted more favourably to the intellectual challenge and social atmosphere. The overall impact of CRTS on the preparation of adult tradesmen, technicians and technologists was tremendous.

Between 1945 and 1960 the manufacturing labour force increased by more than 60 per cent. Immigrant labour played a proportionately larger part in manufacture than in the labour force as a whole. This was the industrial growth of an affluent economy, which had a persistent inflation rate of 2 to 2 1/2 per cent per year. It was embedded in a society committed to full employment, to extensive welfare and health schemes, to ensuring high standards of living and to a vast expansion in educational opportunity. This led to significant individual and small business investment, to the strengthening of existing, and to the formation of new, industrial enterprises, and to a changed employment structure. Industries in six categories showed enhanced employment prospects. These were electrical, plant and equipment, motor repairs, iron and steel, paper products and motor bodies. Decline was most marked in the clothing and textile industries. High employment levels offered a measure of consumer and investor confidence, untrammelled by the impact of rapid technological change still twenty years away. It was a type of euphoric state apparently never to end.

During this period of affluence the first significant intervention for education by the Commonwealth Government occurred. It assumed a national responsibility for leadership preparation in industry, commerce and the professions. The Murray Committee was commissioned by the Liberal Government to enquire into university education in Australia. In 1954 the Committee recommended substantial funding so as to enhance the quality of university education, especially at the postgraduate level. In so doing it justified a very significant contribution to the national economy. During the next ten years, thanks to this stimulus, the number of bachelor degrees awarded rose by 67 per cent and the number of higher degrees by 125 per cent. Much of this higher degree emphasis was in faculties of science and technology. In a period of relatively full employment this represented a significant input to Australian industry.

Departments and Branches of Technical Education across the States responded to pressure from industry for better trained apprentices and operatives. The movement towards day release offered trainees a sounder basis for coping with technical college courses, which emphasised the principles underlying industrial practice. Course outlines became definitive and clearer, and the links between college training and the real situation at the workface were better articulated. In Sydney and Melbourne separate teacher training centres emerged. These and related efforts in other cities did much to strengthen the competence and confidence of technical teachers.

Meanwhile in secondary schools manual training focussed on the development of proficiency in manipulative skills as an educational goal, not necessarily as a basis for entry to industry. In consequence, students coming to technical colleges from secondary schools had been offered a manual training component that was still too stereotyped, being confined to basic skills with wood and metal supported by technical drawing.

The 1960s was one of those rare cornucopia periods when it was apparent that the Australian economy was locked into a continual process of growth. The rate of growth in wealth was so high that even relatively mild redistributive processes ensured that nearly all sectors of the community benefited. Growth was the order of the day and bigness became the test of effectiveness both in the private and the public sectors. The pendulum shifted towards manufacturing. Of about 4.9 million people in the Australian labour force at the 1966 Census - including employers and self employed - about 1.3 million or 27 per cent were classified as in manufacture; primary production and mining accounted for less than 11 per cent. The Vernon Report (1965) concluded: "The proportion of the work engaged in manufacturing is higher in Australia than in many major industrialised countries, including Canada, France and Japan, but it is lower than in the United States, West Germany, the United Kingdom, Sweden and the Netherlands". Australia had emerged as a middle order industrial nation.

There was in this growth period strong demand for talent. Promotion became the outward and visible sign of inherent worth. There was generated an economic and social climate that was exciting yet illusory. It was set in a period of relative international stability and shrouded in a philosophy that promotion and advancement were natural and inevitable rewards.

Within this affluent economic climate, with the presumed continuation of an annual rate of growth of 4 per cent in GDP, the Martin Report of 1964 offered a significant stimulus to the technological sector of tertiary education. The Liberal Commonwealth Government accepted the major thrust of the Report that there be a considerable financial boost to the so-called Institute of Colleges. These institutes of technology were providing industry and commerce with an alternative to the university graduate. These diplomates were much sought after by employers in that they had a much more practical orientation, often through sandwich courses. The Martin Committee framed its recommendations in the belief that "education should be regarded as an investment which yields direct and significant economic benefits through increasing the skill of the population and through accelerating technological progress". The successful institutes of technology in the cities and larger provincial towns of Australia are testimony on the investment by the Commonwealth Government in this sector of education.

During the 1960s technical colleges differentiated course offerings extensively so as to meet emergent specialisations within industry and commerce. This was especially so with post-trade and certificate courses and with new courses designed to meet differentials within industry. Technical college authorities used advisory committees so as to have the fullest input of employer, employee and community perceptions. In this way they not only assessed the needs of industry and commerce but also educated managers and employers to refine their needs. This latter was most apparent in the provision of middle level courses for technicians and managers.

Reforms in secondary education were characteristic of the 1960s. The Wyndham Report of 1957 was progressively implemented from 1961 onwards. Its effect was to offer a wider range of electives beyond a core of English, Mathematics, Science and a social science. It led to the demolition of a rigid structure of secondary education and its replacement by comprehensive area schools. Similar movements occurred in other States, primary and secondary education being their statutory responsibility.

In the process of orientation to the wider community, secondary schools became more aware of relationships with industry and commerce. The subject variously known as Manual Arts or Industrial Arts or Technical Studies revealed a shift of emphasis towards plastics and other new materials used in industry. There was a freer approach towards individual choice in design and construction. The subject began to be taken by girls as well as boys and tended to enjoy greater parity of esteem.

The grand, confident expression of the fabulous 1960s collapsed with surprising speed in the early 1970s. The sweeping oil price increases of 1973 coupled with American policies for financing the war in Vietnam heralded a gross rise in inflation world wide. The 1970s became years of stagnation for Australia with a marked under utilization of productive capacity and relatively weak levels of investment, particularly in manufacturing. This was compounded by the growing militancy of the trade union movement with consequent rapidly rising wage levels.

Within this declining economic climate the impact of technology has been more closely scrutinised. Technological change necessarily implies risk and uncertainty. During the 1970s two very important economic developments were evident in Australia. One was the manifestation of a wider international phenomenon, the decline of the rate of growth of the world economy. This led to a general rise in the level of unemployment among most of the industrialized economies of the world. Australia showed the most pronounced increase in unemployment of these economies. The second development was a change in the general emphasis of government policy on protection of manufacturing industry in Australia. This came about through a tariff cut of 25% across the board by the Labor Commonwealth Government in 1973. Suddenly manufacturers were placed in a less competitive position internationally through this partial withdrawal of protection. Of significance to education was the imperative that Australian industry, and the manufacturing sector in particular, should become more competitive and more export oriented.

With this dramatic economic downturn and the challenge for industry to become more competitive, it was natural for the Commonwealth Government to set up an enquiry into the nature of courses within technical and further education, their relevance to the needs of industry and commerce, and the financial boost necessary to maximise the output of quality students. The resultant Kangan Report of 1974 is regarded as the watershed for technical and further education. The Report strengthened the identity of TAFE, the generic term to cover the several State provided systems of technical and further education. In espousing a philosophy of recurrent education and access, the Kangan Committee provided the basis for breaking down the barriers between course levels in the systems and for offering scope for access to courses with advanced standing. So as to achieve its objectives the Kangan Committee recommended an infusion of 100 million dollars to TAFE throughout Australia for recurrent and capital needs over an eighteen month period. In 1975 the Commonwealth Government, in accepting the major recommendations of the Report, established the Technical and Further Education Commission (TAFEC) to formulate and administer the Commonwealth program of financial assistance. In the very decade in which the economic downturn was most pronounced, with high levels of unemployment and under utilization of productive capacity, there was a dramatic change in the number and size of technical institutions and in the student population therein. By 1980 there were almost one million students in 1248 technical institutions, some 219 of these being major TAFE colleges.

There was corresponding increase in the status and scope of Industrial Arts within secondary education. Depending on community and school resources the subject embraced graphic arts, ceramics, lapidary, leather work, plastics, farm mechanics, bookcrafts and art metalwork additional to technics related to wood and metal. In the senior secondary school engineering science, technology and design are matriculation subjects. Moving closer to industry is the stimulating pilot course "Industry Studies Project" offered in some Sydney high schools to Years 9 and 10 students. The proponents of this course argue: "If our education is to transmit culture then a study of industry is surely of some importance. A student must benefit from an understanding of our industrial and technological way of life".

As Australia moves into the 1980s the focus is on the implications for education and society of technological change. This is interpreted as part of a whole set of social changes which must affect schools and curriculum. Some of these social changes are interrelated, some are irreversible, some are tension ridden. It is ironic that rapid technological change is occurring within a nation beset with major social problems such as high unemployment, shortage and unequal distribution of non-renewable resources, concern about pollution and nuclear fall-out, changes in family patterns and sex roles, and the development of highly centralised organisations.

The relationship between technological change and education has been the subject of two reports commissioned by the Commonwealth Government in recent years. Each committee was bedevilled by the constant difficulty of welding together and fulfilling the several legitimate goals concurrently pursued by education systems and institutions.

The Committee of Inquiry into Technological Change in Australia (the Myers Report) perceived the relationship between technological change and education to be both simple and direct:

1. To benefit from technological change all members of the community require 'appropiate education and training'.

2. 'Appropriate education and training' rests upon a foundation of literacy and numeracy.

3. Study of the physical sciences and mathematics in the upper secondary school is the key to working and living in a period of rapid technological change.

4. The nation's primary school teachers must become mathematically oriented.

5. Girls must be involved in technological courses.

Prior to this, the Williams Committee had been asked to inquire into education, training and employment, not separately and fully in each case, but only in so far as it perceived a relationship to exist. The tendency of that Committee was to look at education as a vehicle to provide training for employment. This could be achieved through short intensive full-time courses to retrain workers affected by technological change or to upgrade the existing skills of tradesmen. There was a plea for greater flexibility in technical education to achieve this. As did Myers, so did Williams stress the extent to which technology should be perceived as a system embedded in a social context.

There can be no doubts about the place and influence of technology in Australia today. The rate and level of adoption of new technology is the most important determinant of the state of the economy and is responsible for much industrial and social change. The low rate of development and adoption of technology by manufacturing industry has contributed significantly to its continuing decline. Technology is the cornerstone for succesful and vital interaction between industrial development, societal change and education in Australia.

TECHNOLOGIES AND THE CURRICULUM CHOICE

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1. Technologies, not technology

Although the word technology is apparently allembracing at its conceptual level, the picture is far less clear at the level of practice. Technology or 'ways of producing' implies a plurality of techniques rather than a one best way. Throughout history, societies have developed technologies suitable for their own needs. However, even such a simple sounding statement conceals more than it reveals. When a society's 'needs' are mentioned, there is a danger of making a misleading assumption that a society's members have equal say in determining its needs. The historical and antropological records refute this.

Yet many educators assume that there is one technology only, Western Capitalism technology (WCT), that is worth curricular attention. Other technologies, if considered, are regarded as eccentric, old fashioned, or at best, tributaries that feed into the mighty river of so-called 'Western' technology. This last viewpoint is perhaps the most disturbing, adopted as it is for what is claimed are the best of liberal or even radical intentions. An example of this may helpfully underline the dangers of this approach.

In an attempt to demonstrate the contribution of non-white societies to Western thought, many curriculum innovators argue for the teaching of Arabic contributions to the mathematics and natural sciences, two key discipline bases for an understanding of capitalist technology. What is done however, is that the contributions that relate directly to capitalist technology are explored while the rest are unexplored and often unknown.

At this point it is helpful to clarify what is indicated by the somewhat loose phrase 'Western Capitalist technology'. Often referred to as 'Western' technology, it is in fact the specific technology that developed in Western Europe from the late 16th century in association with the growth and development of the capitalist economic system and mode of production. Today, capitalist technology can no longer be so simply located in geographical terms: its principal centres are North America, North West Europe and Japan. In addition it could be argued that the USSR is another centre, despite its claimed rejection of the capitalist mode of production. Its retention of capitalist technology with its differing mode of production explains some of the paradoxes in Soviet economics and curricular aspirations. Current soviet fears that the importation of new Western technology may bring in undesirable ideological consequences, as evidences in the work of Parrott (1983) and Hoffman and Laird (1982), presuppose an ideological purity (i.e. anti capitalist) within existing Soviet technology. Yet the continuous debate within the Soviet education system about the differential status afforded to manual and mental work reveals that WCT and its sustaining ideology was not totally swept away in 1917.

As well as being concentrated in specific regions, WCT is also essentially patriarchal, (Faulkner and Arnold 1985). United Nations statistics reveal that women, half the world's population, do two thirds of the work, gain one tenth of the world's income and own one hundredth of the world's property. If technologies' benefits to humanity are to be measured in such terms, women have clearly lost out, and continue to do so.

Although the majority of modern states are dominated by this single perspective on technology, it is by no means the only one. Two examples, one, in WCT terms, 'simple', the other 'comple', illustrate the range of efficient and effective technologies that are very much alive and kicking today.

The first example concerns the so-called Bushmen of the Kalahari. Long considered by traditional anthropologists as a classic model of a so-called primitive people, more recent analysis has revealed not only a comple social organization, but a technology that sustains a people in an ecology that is uneasily considered as beyond the limits of WCT. A similar case has also been made for the Australian Aboriginal technology. That such people have been marginalised and all but exterminated by proponents of WCT is indicative of its dominating and extirpating characteristics.

The second example is from Vietnam. In his book Chickenhawk, Mosen relates how, as a U.S.Army helicopter pilot, he walked through a deserted village that had been 'liberated' by the U.S.Army. Finding the empty home of a local carpenter, he was struck by the beauty, the utility and simplicity of the bench he found there. Solid, sturdy, it was held together without glue or nails. He took the bench back to his helicopter. When his crewmates saw it their comment was that it was typical of the 'Gooks' that they could only manage a technology that did without nails and glue.

Behind both these examples is the idea that WCT is not only a superior technology, but is also the technology towards which all other technologies should either aspire or are developing. It is a more worrying form of earlier archaeological theories of cultural diffusion, under which a 'superior' technology evolves in one society and then spreads,like a plague bacillus, to adjoining societies. Tree ring and other forms of dating have exploded this archaeological theory (Renfrew, C.1978). A similar perspective is needed in the comparative analysis of technologies and their impact on education.

2. Ned Ludd as prophet: the neutrality of technology

To be a Luddite in English is to be closed-minded, backward-looking and resistant to change, all in a pejorative sense. Associated with this is the view that a Luddite is potentially both mindless and dangerous. This is reinforced by the common historical view that is given of the Luddites. Bands of desperate men, roaming the English countryside, rick burning and destroying the early nineteenth century equivalent of the new technology. The bands were rounded up and many of them, including Ludd, were executed. What in fact were they doing? The new technology of the Industrial Revolution was, it is true, leading to a massive expansion of England's wealth and power. But the wealth and the power were concentrated in the hands of those who owned and/or controlled the new technology. For Ludd and his followers, unconsulted about the changes which where so dramatically altering their lives, the future was one of increased pauperisation and powerlessness in Blake's 'Dark Satanic Mills'.

They, and many like them, now forgotten in conventional history, found that the introduction of new technology was anything but a neutral phenomena as some comparativists have claimed (MacLean,M.1984) of its contemporary manifestations. WCT is rarely neutral, in its conception or in impact upon people's lives. Invention and development do not take place within a societal vacuum. An example of this is the way research is currently funded in universities throughout the world. Much is directly funded by agencies concerned with warfare such as Defense Ministries and arms manufacturers; capitalist industry provides another significant proportion as do other government agencies, but often they desire practical technological outputs which will be entrepreneurially exploited. So called 'pure' research, it is claimed, still exists, mathematics being an oft cited case. But even here, funding may be continued because of the realization that the pure research of yesterday can be the basis of the applied WCT of tomorrow. Current developments in cryptography, for example, have their foundations in abstruse theoretical mathematics dreamed up, many years earlier, as 'pure' research.

In many leading WCT countries the fear of Ludditism persists: much is made of the reluctance of workforces to accept new technologies which are claimed to be more efficient and cost effective. It is seldom the workforce. WCT is neutral neither in its academic developments nor in its economic and military applications.

WCT has been introduced into nation states, whose current technologies may derive from different traditions. The literature of development education is littered with case studies of the foreseen and the unforeseen consequences of such introduction. If a shoe factory introduces WCT, it may produce shoes that are cheaper (and possibly better) than those produced by existing technologies. The factory workforce may well be better off than previously in material terms. But practitioners of the indigenous technology, in this case, large numbers of local cobblers, are priced out of the market in an economy that often can find no further place for them. The shoe factory profits are shipped, in part or in whole, out of the country with obvious consequences for the local economy. The process, if anything, is yet more marked with extractive WCT. Even if nationalised by the state, as has happened in the case of Gulf oil states, existing technologies are displaced, their value often realised when it is too late to save them.

This displacement is important, not for reasons of nostalgic preference for other technologies, which we would label as ethnotechnology, but because a culture and its technology are intertwined in a highly complex manner. In other words, WCT is not only not neutral in its conception and consequences at the level of production, it is not neutral in ideological terms. WCT contains within it an ideology that sustains much of the following:

a. a belief in the inevitability of technological progress and change;
b. a belief in the inherent value for humanity of such progress and change;
c. a belief that the social relations engendered by such technology are liberating;

d. a belief in the superiority of WCT over other 'primitive' or 'non-scientific' technologies;
e. a belief that to be 'modern' implies acceptance of, and enthusiastic support for WCT;
f. a belief that WCT produces profit (used in the widest sense of the word) for all involved, however indirectly;
g. a belief that the complexity of WCT requires an education system that can meet its ever growing demands for a skilled (and compliant) workforce.

In sum, the technology that erected Zimbabwe can only be adjudged inferior to the technology that produced the non-stick frying pan: the education embodied in Angkor Wat is inferior to that provided in inner city schools in London and New York.

3. Teflon and the technological curriculum

If it took a man on the moon to provide us with the questionable virtue of the non-stick frying pan, WCT can hardly be said to be one hundred percent efficient. Yet the values embodied in WCT imbue the curriculum of most national educational systems throughout the world. We take the view that the values and ideology of the dominant technology, currently WCT, are reflected in school curricula. This is, in a sense, nearly repeating in a slightly different way what many radical writers on the curriculum have been asserting for a considerable number of years (Bowles, S. and Gintis, H. 1971; Apple, M. 1977; 1982). Educationists and others of a more conservative frame of mind have been arguing the same for a far longer period. The growth of formal technical and vocational education in many nation states is evidence of this. Three questions, however, arise from these assertions, and require closer examination, namely:

a. Can education systems select between technologies and on what criteria?
b. Can a technology (specifically WCT) be adopted in the school curriculum without the wholesale adoption of its values and ideology?
c. Can the school curriculum enable children to make choices about technologies?

Criteria for selecting between technologies can crudely be polarised as short-term cost-effectiveness against long-term cost-effectiveness; external profitability versus internal public good; potential for political and military control versus potential for developing self-determination. The impact of WCT both on its own centres and on the peripheral areas where it has encroached is overwhelmingly towards the first section of each of these polarities. Backed by the political and the economic power of the U.S.A.and the E.E.C., WCT has brought about the destruction of the Amazon rain forests and the canals of Bangkok, has supported profits from Latin America back to the central metropoles whilst health and education for the peripheral masses are largely neglected, and has supported no matter how corrupt regimes in South Africa, Guatemala or the Philippines in order to protect its investments and profits. Some of the educational implications of the international relations of WCT have been explored under the theme of dependency (Coulby, D., 1984). But school systems, even in the countries where people are aware of these criteria polarities, can hardly select between technologies. Resistance to the social, economic and ideological invasion of WCT can hardly be fought at an educational level.

When nation states have attempted to resist Western influence they have often found themselves striving to take technology but to reject the ideology. The example of the Soviet Union has been mentioned. The cultural revolution in China may be seen as an experiment in resisting the ideologies and mode of production implications of WCT. Ironically, now that this trend has been reversed it appears that the WCT base in Chinese cities is still not strong enough to sustain a commensurate curriculum (Ma, L. and Honter, E. (eds) 1981; Whyte, M. and Parish, W., 1984). The old polarities of communist versus capitalist hardly seem relevant here. WCT carries with it a specific mode of production, an implicit set of social relations and a consumerist ideology. Political systems may attempt to modify or distort these aspects, but in a world system dominated by WCT political events and rhetorics may point only superficial differences.

The third question concerning curricula which enable pupils to make technological choices is considered in the final section.

4. Curriuculum choices: the Transmission of technologies

Since the 1976 Ruskin speech by then Prime Minister Callaghan, there has been an increasing trend in the U.K. towards stressing vocational elements in the school curriculum. Led by the Manpower Services Commission, which is responsible to the Department of Employment rather than to the Department of Education and Science, this trend began by providing low quality training for unemployed school leavers (the Youth Training Scheme). Under the influence of the MSC and with the encouragement of the government's monetarist dogma these vocational aspects soon penetrated the secondary curriculum through changes in the examination structure and the introduction of the Technical and Vocational Education Initiative. By 1985 these trends were penetrating to both primary and higher education. The green paper of 1985 puts great emphasis on the importance of technical and scientific subjects whilst suggesting that arts and "non-vocational" social science subjects should be given considerable less pre-eminence. The implicit link in the U.K. and elsewhere in the E.E.C. is between technology and vocation. If schools and universities would only teach computer studies instead of sociology and Shakespeare, the argument infers that their students and pupils would be able to find jobs. A move towards even further penetration of the school curriculum by WCT would lead to employment for the four million people currently jobless in the U.K. Economic nonsense ceases to be risible when it is used systematically to interfere with the curriculum of an entire education system.

This paper may have seemed to adopt the deterministic stance with regard to education systems which has characterised many critiques (Bowles, S. and Gintis, H., 1976; Apple, M., 1979, 1982). Certainly change at the level of the school curriculum is hardly likely to be sufficient to resist the encroachment of WCT. Nevertheless, in nation states where educationists and teachers have the relative autonomy to select entirely or in part the elements of the school curriculum, they can assist pupils and students to resist the tunnel vision which is one of the characteristics of WCT. It is possible for schools to teach about the uses and responsibilities of WCT rather than to instill mindless technological skills. Schools can teach about a range of technologies rather than confine themselves to the currently ascendant WCT. It is essential (contra the U.K. green paper) that pupils and students are encouraged to see the links between technology, the mode of production, patterns of national and international social and racial stratification, cultural traditions and political systems. Without this contextualisation of WCT and without access to the knowledge of alternatives, pupils and students will be trained for a place in a system they can neither challenge, understand, nor imaginatively circumvent.

Huge geographical and social inequalities in the distribution of wealth, the proliferation of costly weapons systems at the expence of small-scale agricultural and public health developments, the global spread of lowest common denominator mass culture (American T.V. dramas, European pornography, Japanese video-games) all point to the insight that WCT is not the one best way. Other alternative technologies have been developed in the past and are being developed today. Schools and universities in many nation states still have the power or the autonomy to equip their pupils and students with the imaginative and technical capacities necessary to criticise WCT and to generate alternative possibilities. It is essential that this autonomy is used to develop and maintain a sufficiently broad based and critical curriculum.

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TECHNOLOGICAL CONSTRAINTS - UNEMPLOYMENT OF YOUNG TEACHERS: CHALLENGES FOR INITIAL AND IN-SERVICE TEACHER TRAINING IN THE FRG

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The Federal Republic of Germany (FRG) - as other industrialized countries also - is facing a rapidly growing process of social and technological changes. "Progress" - whenever this has been a value in itself - today is closely connected with an introduction and dissemination of new media (cable TV, satellite TV, cable-communication, private radio and TV etc.) and overall computerization. The infrastructure for easy exchange of a great mass of information (via cable or satellite, networks etc.) is under construction. All these changes seem to lead to an "information society", which is proclaimed to be the best way into future.

In terms of knowledge a new educational crisis is forecast by some experts if there is no rapid introduction of "computer-literacy". Even the position of the Federal Republic of Germany in international economic competition seems to be endangered if "computer-illiteracy" remains. At the same time a vast spreading of privately owned microcomputers through schools is regarded to be a reasonable strategy. Unfortunately there is still a great misunderstanding concerning the amount of knowledge, skills and experiences in connection with computer-literacy. Mostly some kind of greater acceptance towards computers in connection with some basic user skills are the major aims.

But these aims are not sufficient for a democratic society. In the same way as a mass of people had been locked out from knowledge before literacy (reading, writing, etc.) was delivered by schools to everyone and not only to a small elite we are now facing a situation that new kinds of illiteracy may grow again. This development will be the more likely as restricted aims in computer-literacy for example are closely linked to a new debate on elite-education, special support for the gifted children and a strict refusal of higher priorities (in terms of public financial support) for education and the school-system in general.

1. Computer, new media and illiteracy of teachers

1.1. Comprehensive literacy today - illiteracy of teachers

Industrial states like the Federal Republic of Germany are in transition to a so-called "information society" or "communication society". The common core of this development is an introduction of computer and data-processing in nearly all branches of the economy and social life. Experts say and write a new "education crisis" is knocking at the door for several reasons:

1. Children tend to stay more hours per week in front of a TV-screen (with TV, video etc.) than in the class-room.
2. Computers ask for new basic knowledge that can't be provided by the school as it is now.
3. Teachers in school, rather old in terms of computer-industries, are not trained to work with these tools, they often are not willing to accept them.

What is new with the basic norm "literacy" in school?
Normally literacy is commonly understood as "being able to read, to write and to calculate" at various levels. These levels start from the basic skills in primary education to become rather sophisticated abilities in secondary education. Today there is clear evidence that this kind of literacy has to be enlarged to a high degree. Specially two areas must be added:

1. Computer-literacy, to be able to make use of this kind of technology in a passive - or understanding - and in an active way - to work with, to handle and to transform it.
2. Audio-visual-literacy (or in French: alphabétisation en langage total") which means not to be a passive consumer (or often: victim) of audio-visual stimuli only, but to be able to understand the special language of movies etc. by oneself. A theoretical background for this demand lies in the basic values for a public school system: to provide a chance to participate actively in all fields of social, economic and cultural life. People who do not understand important and mighty instruments of communication, who even lose a gained primary literacy (e.g. "functional illiteracy") without understanding what is going on in the mass-media, is handicapped to exercise their basic civil rights.

In this context, assuming that computer-literacy and audio-visual literacy are accepted as basic skills to be taught and exercised at school, the question arises: "who shall do this work?". Most of our teachers today are older than 35 years. Computer-industries usually regard people younger than 30 years as clientele for home-, personal- or micro-computers etc. The age-group of teachers is outside this clientele. At the same time everything connected with computers is highly attractive for children and students, even for those in primary schools. At the same time most teachers do not accept computers in school; they don't know to work with them, to make them an active part of education.

What is said in terms of computers is even more likely to be true in terms of audio-visual literacy. Generally the computer is accepted as a normal tool for coming generations, but looking behind the fascination curtain of TV and video, movie and radio, information- and communication-machinery etc. as common knowledge does not seem to be of public interest. But both kinds of new literacy, in addition to the old and commonly accepted ones, must necessarily to be delivered by school. - Unfortunately most of our teachers today are almost illiterate in these new areas. New teachers have no (or: a very limited) chance to introduce these innovations: they are locked out (see above!!).

1.2. Computer-literacy and in-service training of teachers

To create better chances for new generations on the labour-market, computers are introduced in different ways into schools now:

- special actions, like the joint one of the Federal Ministry of Education and Science and the Federal Ministry of Research and Technology in March 1984, called "Computer and Education". In this action a lot of home-, personal- and micro-computers including software, in-service training, etc. were given to selected schools.
- pilot experiments of the Bund-Länder-Commission for Educational Planning and Research Promotion concerning the introduction of new technologies and special in-service-training programmes for teachers.
- a shift towards computers, informatics, etc. in programmes of the Länder-institutions for in-service training of teachers.

Most of these in-service training activities tend to be short-time activities (one-week-courses etc.). Spreading real computer-literacy among teachers requires long-term courses or activities that start from the given interest of teachers and providing sufficient time (that means: reduction of workload) to accept the new tools, to learn on them and to make their own experiments with them. At least they have to learn one or two computer-languages to make their own programmes or to change given ones. To pay for new teachers who can replace those in long-term in-service training, there is only limited space (or money...).

Taking into account a certain lack of acceptance or some kind of ignorance of computerisation and some bad experiences in connection with the introduction of new media in schools (besides chalk, talk, white/blackboard etc.) it is obvious that a spreading of computer- and audio-visual-literacy among teachers of all types of school, and all subjects can't be successful on the basis of short-time events. The gap between most German teachers minds, their daily work-load and this aim of new literacy is rather great. To bridge this gap means:

- to recognise the link of these new kinds of literacy;
- to introduce new teachers who have followed special training in this area;
- to develop and train the staff or all teachers of special subjects (not only those of physics or mathematics) of a given school in this area;
- to make additional funds available for sound in-service training in long-term events (such as sabbatical year, replacement of teachers who attend in-service events etc.) instead of just spreading some hard-ware plus short-term courses and a lot of (cheap) advertisement on the "information society".

2. General outline of teacher training and employment

Teacher training is - in a functional way - understood as a life-long perspective, starting with the initial phase of training followed by in-service training for the appointed teachers.

Prerequisite for the initial phase is the final school leaving examination (Abitur) after 13 years of schooling, specially the nine or seven years in upper secondary schools. The initial phase of teacher training itself is subdivided into two separate phases:

a) teacher education at university level (3.5 - 4.5 years at least) ending with the first state-examination which normally is provided by the university;
b) a second or induction phase at a special seminar and in school; the seminar - as a training agent - is part of the school administration. Normally the second phase takes one and a half year. This phase ends with the "second state-examination".

Teacher training as a whole takes 5-6 years at least, plus a minimum of 13 years in school. After the second state-examination applicants for a post in school have had at least 19 years of learning and are 25-27 years of age.

Big problems arise when people of 25-27 end up with their teacher certificate and have no chance to work in this profession.

They are older than other applicants for other vocational training. They start their professional careers as unemployed.

Besides the age-factor poses serious problems during the second phase specially when there are applicants whose professional failure or problems are obvious to the trainers. There is no or little selection in the first phase, the vast majority of students succeed in this phase, no selection or practice-oriented counselling takes place at the beginning of studies.

Both "state-examinations" are a prerequisite for the employment of a teacher. In fact the monopoly of employment of qualified teachers is held by the state itself. Only very few teachers are contracted by private schools or other training agencies. Teachers are employed by the state as civil servants normally, this also means they can't be dismissed from their jobs, except in case of involvement in criminal affairs etc.

The monopoly of the state as employer of teachers is also visible in the distribution of pupils/students among state and private schools:

Attendance of pupils/students (1980)

	State	Private
Primary- and Communeschools	99,0%	1,0%
Middle Schools	93,9%	6,1%
Gymnasium	90,5%	9,5%
Vocational schools	95,1%	4,9%

3. New needs, plans and experiences in teacher training

3.1. Teacher training and the employment of teachers

The close link of teacher training and unemployment of teachers by the state has practically come to an end. Only 3 or 4 out of 100 fully qualified teachers have a chance to be appointed after their second state-examination. Today this career is mostly going from school through teacher training to...? This situation seems to end in a complete lack of perspective in the two phases of teacher training. But any discussion on changes in teacher training is without sense, when there is no perspective left to find a job in a school.

3.1.1. Present situation and perspectives

Compared with unemployment on the labour market in general the unemployment of teachers will increase more rapidly until 1990 and later. Currently about 570.000 teachers (in full-time equivalents) are employed. In 1984/85 about 60.000 teachers are unemployed. Moreover 40.000 teachers are working on contracts of limited duration and/or imposed reduced working time.

In case 570.000 posts for teachers in full-time-equivalents will be kept over a long period the following figures seem to be reasonable:

unemployment of teachers

	absolute	relative
1982/83	30.000	5%
1985	70.000	12%
1990	172.000	30%

The relative degree of unemployment in general is about 10% in 1984/85.

To keep up 570.000 full-time equivalent posts has several prerequisites:

1. All teachers leaving school will be replaced.
2. All posts will be filled again, when teachers go on part-time occupation voluntarily.
3. Special needs are to be fully recognised, like a reserve of teaching staff for maternity leave, for leave in case of in-service participation, small schools, promotion of migrant children, promotion of handicapped/gifted children in general education, reduction of work-load per week.
4. The demographic development with decreasing numbers of pupils/students is to be used for improvement of schools.

The economic situation and more than 2.3 million unemployed people as official figures indicate, seem to be the worst conditions to fulfil these four prerequisites. This means the perspective of unemployed teachers and students in teacher training is even worse than indicated in the absolute and relative figures above. It is more likely that only the smallest portion of teachers will have a "chance" to get a job. Some generations of fully qualified new teachers will be locked out from school for 10, 15 or more years. Demographic development shows a total decline to 8.4 million pupils/students in 1990; to keep the given student/teacher-ratio of 19:1 (as in 1983) there is a necessity of - globally seen - only 450.000 jobs in full-time equivalents. About 120.000 jobs (= more than 20%!) could be taken from the payroll.

But a realistic point of view gives evidence that at least 570.000 full-time equivalents will be needed to bridge a gap that is always producing public annoyance: to see unemployed teachers out of school and lots of lessons not being taught in schools for various reasons. Parents have no possibilities to institute legal proceedings against loss of lessons. Rough figures show one year of schooling in ten gets lost for the reason that lessons must be dropped from the time-table: lack of teachers, in fact. Only public pressure in this area and a higher political priority for education are able to change this situation.

Official reactions to the "senseless" production of new teachers through teacher training hit teacher training itself. A vast majority of educational officials claim and will practise a nearly complete reduction of teacher training as soon as possible. Reactions of teacher training institutions to this policy absorb a lot of energy. There is no time and energy left for discussions on the reform of teacher training (in structure and content), to make use of the outcome of former pilot-experiments etc.

What was a great success in the history of teacher education in the FRG in the 1970ies - the integration of all types of teacher training into universities in almost all states of the FRG - is now proving to be the smoothest way to reduce initial teacher training capacity drastically. Nearly all posts of permanent and part-time staff becoming vacant are taken away from teacher training to other faculties within the university. Staff-members who leave teacher training in universities are not replaced, thousands of posts are lost for teacher training and it will take a lot of time to establish them again, when there is public recognition of a new lack of teachers.

The perspective of teacher training is similar to the one we had 100 (!!!) years ago:

a lack of teachers
(1960ies and early 1970ies)
was followed by

an overproduction of teachers
(mid 1970ies-1980ies)
was followed by

a reduction of teacher training
(beginning 1980ies)
was followed by

a lack of teachers
(mid 1990ies-20...)
.....

3.1.2. Integrated policies to overcome unemployment of teachers

The Standing Conference of Ministers of Education as well as the Federal Ministry of Education and Science and the Bundesländer Commission for Educational Planning and Research Promotion have taken a lot of steps to prevent the unemployment of teachers or to diminish it as far as possible. Since the midst of the 1970ies information was produced concerning the decline of the demand for teachers, possible overproduction and unemployment. All this information did not prevent overproduction and even had only limited influence on figures concerning new-comers to teacher training. When no primary-school teachers were employed in the late 1970ies, students in primary-school teacher training shifted to secondary-school courses. This was easily possible as various types of teacher training had been integrated in universities before. The shift to another type of training is connected with the inclusion of great parts of the preceding course in the following one. Many seminars, lectures etc. in teacher training are designed for various categories of teacher-students.

Meanwhile low salaries in the second phase have been reduced twice; structural changes diminish salaries for everyone new in the public service for four years. Possibilities to leave the teaching job for some years (without pay) on a voluntary basis have been enlarged as well as part-time work in school.

Pilot experiments have started to find out new ways to give teachers a chance to find jobs in other industrial, administrative (except the public service) or management functions. But these experiments, specially supported with financial aid from the Federal Ministry of Education and Science through the Bundesländer-Commission, cover only very limited numbers of teachers.

Through additional courses a lot of teachers are newly trained in data-processing, computer-operation etc., mostly by the labour-market agency. Teachers are also taken in by the banking system in single cases.

As a whole all these initiatives try to bring individual chances to unemployed teachers outside the school system. The question, "how many teachers are really needed?" is no longer asked by official agencies, for the answer is obviously: "Maybe there is still a need today, but there will be no need tomorrow... and there is no money today to pay them...".

Besides these official initiatives a lot of unemployed teachers try to organize alternative educational working possibilities. There is a growing net of cooperatives and mostly local self-help groups. These groups are working in educational areas that are normally tasks for the official educational system, but covered by the work can't be done because there is - officially - a lack of money.... . These initiatives of the unemployed are often supported by the Trade Unions, which also organize regional and federal meetings on these initiatives.

4. Concluding remarks

A huge spreading of new media and computerization in nearly all parts of social and economic life is bringing up a great demand for new kinds of literacy. To restrict this demand to some basic skills means to diminish the possibilities of learning, insight and knowledge. Audio-visual literacy is necessary as well as computer-literacy, for the very reason more and more there will be a greater amount of leisure time; more and more TV has become a third dominant factor in education besides parents and school. To be active and trained in the audio-visual area is as necessary as reading and writing for the very reason that communication and learning will be increasingly coming through this channel. There is clear evidence that computer-literacy can't be neglected.

What is wrong with computer-literacy today is not computer-literacy itself but the circumstances that prevail at public discussions especially of the mass-media. Computer and computer-literacy have become idealistic miracle-words that hide a lot of existing social and educational problems and seem to solve them. But they can't solve the problem of unemployment of teachers on one hand and lessons not being held every day/week/month etc. for the reason of a lack of teachers inside school on the other. Perhaps it is a bad joke to see unemployed young teachers sitting in computer-courses to be retrained as operators when their colleagues in school have serious difficulties to cope with the spreading demand of parents and politicians and school-administrators to teach computer-literacy or at least something that is regarded as such, but that will be outdated when students leave school.

The Federal Republic of Germany is in a way comparable to the one the USA are in. Joseph Weizembaum, Professor of the Massachusetts Institute of Technology (MIT) characterized the role of computers in American education in the following way:

"Now let's answer the question, whether computers can heal everything. The best example in this context is the use of computers in American schools. The American school-system is a catastrophe. A government report says, our schools are producing a wave of mediocrity.

About half of our students leaving after twelve years of schooling can hardly read and write nearly nothing. And now we have a huge wave of computerization in schools. It is said, they are making everything good again. But this is not true. The computer is taken as an excuse or not asking more questions. We say: Johnny can't read. Instead of asking, why Johnny can't read we provide him with a computer; perhaps it may help him to read. But when we ask, why Johnny - in a country as rich as the USA - can't read, the answer is, Johnny is probably hungry when coming to school. If you do not put forward this question you can't find a way to answer, why Johnny is hungry.

The President of the USA - Reagan - some days ago said the greatest problem in American schools today is security: violence of students against students and students against teachers. In this system of schools we place computers to heal everything. This is a 'technological fix' as we call it."*

If computer-literacy shall be more than a 'technological fix' it requires a sound educational system and must be integrated with traditional literacy and audio-visual literacy. But this needs teachers to do it, teachers who are now either locked out as unemployed or overloaded as professionals in schools.

* Translation by the author from a speech in German by Joseph Weizembaum, quoted from: "Symposium der Hessischen Landesregierung Informationsgesellschaft oder Ueberwachungsstaat Protokoll", Wiesbaden 1984, Seite 55/56

TECHNOLOGICAL DEVELOPMENT IN INITIAL TEACHER EDUCATION
THE CHEMISTRY FORUM

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1. Introduction

The impact of technology has been progressively changing the way of life in modern societies. In general terms technological developments have contributed to easier or better living conditions, however they have also had a reverse side presenting problems whose consequences were at first unforeseen but that in many cases became an object of major concern. This may be summarized in a short statement "each conquest has a price" (1). The technological revolution has been provoking a break of continuity in different areas.

Materials.
From building to clothing, from domestic ware to space vehicles, a variety of materials not previously present in nature have been developed and commercialised for a multiplicity of purposes.
Communications.
Capability of instantaneous contact with any country in the world and access to information about facts which are occurring in the most distant places by photon pulse or continuing flux (2).
Bio Technology.
Man is now able by Genetic Engineering to build new gens and DNA cross molecules with useful finality and unknown consequences.
Destruction.
Never before any country or single person was able to produce such destructive effects over individuals, nature, even earth.
Processing of information.
We have now the possibility of commanding computers which "think" faster and work multiplicities of stored information.
Domestic technologies.
These have completely changed traditional activities in terms of effort and time but force an inherent increase of energy consumption on us.
The conditions under which societies and individuals live and act

are subjected to dramatic changes. These require an objective and deep analysis in order to have the most of the offered advantages, to minimize the adverse aspects and to identify those components which to be supressed.

The role of science education is preminent in this context; the understanding of the concepts behind the use of science may be part of the curricula, also the objectiveness required in the analysis of the effects finds an adequate environment in the science class.

2. New aims for science education

Modern science teaching recognizes that science, more than a body of knowledge, is an attempt to understand the world. Accordingly, experience and participation are emphasized together with the development of children's abilities to think critically, to seek and use evidence before dropping conclusions and to begin developing some other more complex intellectual skills. However, it is quite controversial if we should consider the products of science as just ideas (concepts) if the products include what previously did not exist in nature and are used by society.

We have defended that the ability man has to change life and the environment is a result of science, controlled by social, economical and political factors (3).

As a result, we assume that students should get their view of science starting from nature and from everyday life experience and these should always be present when the concepts are generalized or expanded. As an illustration we can mention the introduction of the concepts of acid and base at general level. Instead of or together with chemical materials, natural products and soft drinks, shampoos, cleaning agents should be used in the teaching process. In addition, a last stage should include a critical view of advertisements which publicize some desirable characteristics of the products which are not present, (pH of shampoos, vitamine C in soft drinks). We should refer to the safe use of cleaning agents, which are commonly assumed to be products with no special risks for domestic purposes.

The use of science cannot be discussed in isolation from values of society and in this context science teaching may be a value laden discipline (4).

Science students should understand that the method of science enables man to come to a great understanding of nature and better living conditions but from the same concepts and by the same method adverse results may be derived accidentally or purposefully. A typical example which illustrates these principles is the teaching of energy (5). Our society depends on energy. If considering energy resources and energy storage, we go back just three centuries, we can easily conclude that modern societies could not have survived. This is not a question of available knowledge, more but of its use by society. On the whole for most members of our society the gain has undoubtedly been positive, regardless of some side effects like pollution from coal industry, oil tanks or nuclear reactors and others. Man looks for alternatives to overcome the price of getting energy out of his resources, alternatives which may cause less environmental problems. It is assumed that in spite of the knowledge non available at this moment man using the methodology of science will be able to get a frame of information which enables him to solve, at least partially, the problems he has to face today. In this context it seems quite dramatic to use knowledge and scientific research for war, destructive purposes.

When products which bring or are assumed to bring better living conditions are first introduced in society, they usually are uncritically accepted and welcomed. Only later, when undesirable effects are apparent, society becomes reflexive and may use commonsense or scientific criteria to regulate the use of those products.

Science learning may give students at secondary level thinking strategies and also a referential basis in terms of values to be preserved, namely the respect for nature, humanity and an objective description and evaluation of facts. These students go through a strong conflict situation having to adapt themselves to a variety of experiences and they expect a strong contribution from school to solve the disequilibrium in the situation (6).

3. Short reference to the structure of the degree

Lisbon University awards Licenciatura degrees (5 years) in science (namely Physical Chemistry, Geology and Biology) with specialized branches for teaching and research. To be admitted to Licentiatura degree, students have to take a Bachelor degree (3 years) first in one of those scientific subjects. Students willing to become teachers for the secondary schools , have a fourth year of educational courses and method courses.

This 4th year is intended to enable students to become aware of the responsibilities, activities and skills of teaching. Both the 4th and 5th year carries 30% of the final assessment. The 5th year provides the opportunity for the development, practice and refinement of teaching skills. It consists of training in a high school. Students who receive Licentiatura degree in Physics are entitled to teach chemistry to non vocational pupils and those in chemistry also teach physics. Groups of four to six students are allocated to high schools which volunteer to receive them.

The allocation to high school is organised by the central administration. Approximately 2025 students graduate each year. A teacher from each particular high school serves as a local adviser. The Faculty designates University advisers for each group in the field of chemistry and physics. This academic year, an adviser from Education was also designated for each group. Faculty advisers in addition to helping the student-teachers to overcome difficulties in any matter they may not be handling properly or having particular difficulties to express concepts in easy language, have some leader kind of seminar or monograph which is fixed in the beginning of each academic year.

4. Implications of technological development in teacher training

Preservice training and initial training should provide student teachers with adequate skills to evaluate their students' needs in terms of an evolutive society and to choose the adequate processes to implement those objectives which may defend man from submerging in a technological society instead of getting better living conditions and understanding the human society tessitura (such as mutual comprehension, respect, tolerance, responsibility and active collaboration).

In our work we have stated for a couple of years, from our students' feedback, entering behaviour at "Metodoligia de Quimica", a fourth year methods course, that they do not agree with the formal curricula of the courses required to get the degree. They evaluate most of the courses as too much encompassed in a scientific context, giving poor insight everyday life situations and society problems.

They also seem much critical about the way university professors relate to them. In their own words, they are typically considered inferior to students oriented towards research, instead of teaching.

At this point our student teachers show a strong will of change or reformulation of the teaching practice to which they have been subjected in terms of strategies, student teacher interaction and student student interaction.

However, we have found that in spite of their commitment, the gap between their will and the way they plan their teaching units is wide. In fact, only very few students succeed well in integrating their own principles, those they have evaluated through the analysis of the school system. We have concluded that most of the students, regardless their effort, are strongly limited by the effect of many years of schooling. Their lack of information regarding the integration of science in everyday life aspects also restricts an open coverage of subject matter. Alternatively, irrealistic approaches are developed which do not stand after a first analysis.

In 82/83 our student teachers during their training in high school conducted a survey in their classes to evaluate 8th grade students' feelings about chemistry. From the results was apparent their fear about science and also their expectations about learning "many useful things" for life. We must say at this point that in both high school and faculty curricula there has not been explicit room for any sort of these topics.

A survey of high school science teachers held during an in service course in 1982/83 has shown that 85% of teachers were motivated to include topics related with science to the citizen and for social objectives. Some constraints were identified, namely teachers state their own poor background in interdisciplinary areas and in relation to classes in situations which were not the typical situation "teacher knows all about it".

In 83/84 integrated a unit in our course considering the relevance of technology both in society and in science teaching. The students, organized in groups of two, had to present a report and a communication of 50 minutes about topics related to science, technology and society. Topics were siderurgy, analgesics, antibiotics, forensic chemistry, glass industry, ceramics, packing for vegetables, bread, cosmetics and stearine pollution. Little information was given to each group. They had to find themselves all the information they needed outside school. This unit had a 15% weight in the final assessment of the course. More details are given elsewhere (3). Compared with other tasks they had to perform, this work was highly motivating after the initial steps.

This year each of the authors as scientific advisers from the University has followed a group of student teachers in their training in high school.

We intend to develop and extend this sort of work as part of training to identify the constraints to this innovation and to compare the attitudes of teachers in initial training and in service training.

5. Description of the work

One of the groups (A) working in Escola Secundaria (H.S.) D. Joao de Castro included four student teachers. This group decided, as a starting activity, to evaluate their students' motivations and concerns. The entering behaviour was detected by a survey which revealed their expectations about

- doing experiments in class
- understand nature and the world

- how to fight pollution and protect environment.
- learning useful things for their lives.

In addition some private concerns or problems were revealed by the survey, which, at first, were considered intriguing by student teachers but which, with the subsequent knowledge of the class, they could explain.

The analysis of those expectations enabled us to make two major conclusions for the group work:

- Use of experimentation as a major strategy for the learning of concepts.
- Some answer had to be given to the concern about pollution, creating some space for it in the curriculum of the course.

At this point some agreement had to be made with the local adviser since extra curricular activities are time consuming and difficult to introduce.

We will focus the part of the work which concerns the second point (7).

8th grade students were informed about the organization of an extracurricular activity about pollution as an answer to their concerns and interests. They were asked to develop monographic works on this subject, which was well accepted. Student teachers prepared a play about sound pollution, poetry about water and finally, a song about several forms of pollution and personal responsibility.

A session was held during the morning time and was repeated in the afternoon. The room was decorated with work and posters made by student teachers and their students.

Additional materials were supplied by Comissao Nacional de Ambiente and the Accident Prevention Division of the Ministry of Labour. Some experiments were carried out, namely electrostatic precipitation prepared with the physics adviser, and tobacco combustion, - simulations of the effect of tobacco on the human organism.

Student teachers considered that their secondary school was open to the initiative. Teachers from the same group, geography and biology, participated and invited their students. 9th, 10th and 11th grade students went by their own initiative. Technicians also participated and helped in several activities.

In order to evaluate the session a survey was conducted among 8th grade students. Students considered that chemistry should not be taught dissociated from its effects on society, and noticed that student teachers were highly concerned about these effects. About the same number understood how chemistry can contribute to solve problems caused by pollution. Students also concluded hat this perspective is more motivating and more formative than the way chemistry is taught in classes. Students manifested that their concern about pollution had increased, and were specially concerned about the effects of smoking. Some expressed their purpose to stop smoking.

The survey covered other specific points related to organization, the use of different teaching methods and the suggestion of future activities. The participation of an ecologist was recommended.

Student teachers considered this activity extremely relevant to their training.

The preparation, execution and evaluation of the activity contributed to giving a wider background to this subject, through organizing activities, getting information and materials from different sources. Student teachers recognized the importance of this sort of activities in the context of chemistry (or science education). They enable students to establish the link between theory and life and also to develop different skills and responsibility. They stated that students who were not motivated by classes, became participant, cooperative and enthusiastic. Some characteristics of the students' personality became relevant and give student teachers an insight of how to deal with some problems of the interaction teacher-class.

The local adviser supported the activities and in her evaluation considered that the objectives were fully attained.

The second group (B) of student teachers (5 student teachers) worked in Escola Secundaria (H.S.) Pedro Nunes. They showed much concern about their scientific background, namely in the field of chemistry taught in high school at advanced level. They developed a monographic work about "oxyreduction", considered as one of the topics which present more learning difficulties to students and also more difficulties to student teachers. The work is basically the development of strategies to introduce concepts in the way that is proposed by the 11th grade curriculum for chemistry. They have also included an additional chapter covering the importance of these phenomena in the breathing process and another referring to the interpretation of the mechanism of food additives based on the concepts they had previously introduced.

The difficulties to deal with curricular topics made them unable to introduce any activity relating chemistry and society, including the topics about food additives. Also, their teaching strategies were poor in terms of examples, analogies and interpretations related with everyday life.

6. Conclusions

The introduction of activities relating to or discussing science and society are welcome to secondary school students. Student teachers recognize the importance of those topics in terms of making science sensible to students and give them an adequate framework of judgement. However, student teachers are intimidated by the introduction of topics for which their preparation may not be as good as in curricular topics. In fact, the same was found previously for teachers' in service training (3).

The local adviser has an important role regarding the implementation or non implementation in initial teacher training of topics or strategies which are innovative. Also, extensive curricula or perfectionist attitudes to curricula constitute constraints to the promotion of that sort of issues. The addition of the two factors (local adviser/curricula) may block the student teachers' motivation to introduce innovative aspects in their classes. This was the situation of group B.

Group A, in addition to the objectives they had identified for the pollution activity, achieved a close relationship with their classes, which was an additional reward.

The structure of Licentiatura degree has been undergoing modifications which, we expect, will improve student teachers' background both in the conceptual and in the applied domain. It seems relevant that prior to the beginning of the training work, local advisers are included in the project work.

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TRANSFORMATIONS DU MONDE DU TRAVAIL ET IMPLICATIONS SUR L'EDUCATION

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1. Transferts technologiques

Les conséquences sociales des nouvelles technologies méritent d'être étudiées parce que leur ignorance constitue souvent un obstacle majeur à leur application. Les aspects sociaux, économiques et techniques sont étroitement liés; en effet, l'introduction des nouvelles technologies n'est pas innocente en ce qui concerne les rapports sociaux et de travail, au niveau international. Mais quel est le rôle de l'éducation?

Si on compare l'évolution de la progression technologique depuis la guerre entre les différents pays, on s'aperçoit que l'éducation a joué un rôle majeur en ce qui concerne la performance du développement technologique, scientifique et surtout la capacité d'un pays de devenir exportateur de sa production. Le militaire a joué aussi un rôle dans la production de ces technologies, mais son développement est heureusement destiné à s'arrêter, sauf la destruction de la planète. L'importance des technologies peut être aussi évaluée par le développement impressionnant de l'espionnage technologique, qui est devenu aujourd'hui un des aspects les plus importants dans les relations entre états.

Les pays en développement dans leurs rapports internationaux sont devenus de plus en plus attentifs aux relations et aux transferts scientifiques et technologiques. Ils ont aperçu que c'est autour de ces transferts et de la possibilité de développement national de la science et de la technologie que va se jouer leur destin.

L'internationalisation de la production et l'émergence de puissantes corporations multinationales engendrent de nouvelles formes d'investissement et de commerce extérieur. Entreprises communes, sous-traitance internationale et coopération industrielle internationale sont parmi les nouvelles formes d'investissement étranger (1). Ces investissements créent de nouvelles dépendances et interdépendances dans le domaine de la technologie et de la formation. Ces modalités de coopération demandent que soient prévues des activités appropriées de formation pour les participants nationaux des pays périphériques: cela est le contraire des modalités précédentes d'engagement à l'étranger (vente directe des produits du centre et investissement direct) qui demandaient un investissement modeste dans la formation. Nous devons aussi prendre en considération le fait que commerce et production sont influencés par l'impact des nouvelles technologies ou des structures organisationnelles, par l'internationalisation du secteur tertiaire (recherche, engineering, informatique, consultation des cadres) et par l'introduction des entreprises petites et moyennes dans l'économie internationale (2).

Le débat concernant la technologie dans les pays en développement entre A. Emmanuel et C. Furtado (3) est encore d'actualité. Qu'est-ce qui est le plus important: recevoir la technologie étrangère, ou faire tous les efforts pour développer sa propre technologie? Il serait peut-être plus souhaitable d'avoir une approche plus dialogique dans la recherche d'une alternative au débat entre autarcie et dépendance technologique. Emmanuel a raison lorsqu'il dit que des peuples donnés ont des cultures qui sont liées à leur développement technologique et que, de ce fait, il est inutile de chercher des développements technologiques propres à des cultures données. Furtado a raison lorsqu'il met en garde contre les implications des transferts technologiques faciles qui ne sont pas des transferts réels pour ce qui est de la connaissance et de la maîtrise de ces technologies. Il faut constater sans complaisance que "Pour les produits vendus sur le marché mondial, la seule technologie appropriée est celle dictée par le niveau le plus élevé atteint par la productivité du travail et le rendement du capital, ainsi que par les moyens les plus avancés dont dispose le capital pour imposer sa loi aux ouvriers indépendamment de leur nationalité" (4).

De nouvelles règles concernant l'aspect financier des transferts éducatifs sont nécessaires; les pays en développement sont souvent obligés de dépenser trop pour ces transferts éducatifs, de manière parfois utile, parfois inutile, mais très coûteuse. L'ignorance concernant l'éducation et les modalités de la formation contribue à perpétuer des communications éducatives inégales.

2. Chômage et éducation

Il serait intéressant d'analyser le problème du chômage en relation à l'internationalisation de l'économie.

Pourquoi le chômage frappe-t-il les économies à économie de marché de manière relativement égale et à la même période? La forte compétition engendre une modernisation et l'introduction de nouvelles technologies, souvent avec réduction d'emplois. La mobilité des capitaux, des technologies et des travailleurs rend cette modernisation souvent obligatoire, faute d'un isolement économique impossible à soutenir pour ces pays. La modernisation de l'économie signifie pour plusieurs pays non seulement le passage d'un monde de production à un autre (nouvelle organisation technique et sociale du travail), mais aussi le passage des contenus de la production à d'autres. De là, l'importance d'une formation qui doit s'accompagner de ces changements structurels.

Pour ce qui est des pays à économie planifiée, s'ils sont en situation de développement et avec un marché intérieur relativement autarcique, ils ne sont pas frappés par le chômage parce que la demande du marché intérieur est toujours supérieure à l'offre et certains emplois sont sous-payés. Si ces pays s'ouvrent sur le marché extérieur, à la recherche de débouchés pour leur production, le problème du chômage se présente, suite à la modernisation nécessaire de leurs économies.

Les pays du tiers-monde, ouverts dans la plupart des cas à l'économie internationale, souffrent de manière croissante du sous-emploi et du chômage, en raison de l'internationalisation de la production agricole, avec des agricultures extraverties qui réduisent souvent la possibilité de consommation et de production pour des parties importantes de la population. De là, l'abandon de la terre et le chômage en milieu urbain et péri-urbain. Pour réduire le chômage, les pays en développement devraient "compter d'abord sur l'agriculture, l'industrie de la construction et le secteur des services" (5). Dans ces secteurs, il y a la possibilité de développer l'emploi bien au-delà d'une industrie manufacturière moderne.

Il faut prévoir la disparition d'un nombre important de postes de travail qualifié, par exemple aux Etats-Unis, les robots "pourraient remplacer dans les vingt prochaines années 3 million de postes qualifiés, et potentiellement, en éliminer 8 millions - soit 8% de la force de travail - d'ici 2.025" (6). Par ailleurs, le passage du secteur primaire et secondaire au tertiaire, s'accélère. 60% des travailleurs travaillaient en 1984 dans les pays appartenant à l'OCDE dans le secteur des services contre 50% en 1971, et 42% en 1961. La tertiarisation concerne par ailleurs déjà 69% de la force de travail aux Etats-Unis. Le changement de travail dans la vie varie de pays à pays: en ce qui concerne les pays industrialisés de 2,6 postes de travail pour chaque Japonais, on passe à 7,5 postes de travail pour chaque Américain (7).

Une optique japonaise différente s'oppose à un pessimisme occidental sur le futur de l'emploi. La différence entre l'optimisme japonais et le pessimisme des pays occidentaux (8) est-elle seulement une question de sensibilité, ou plutôt une capacité japonaise (et chinoise aussi demain) de mieux gérer l'innovation?

Il serait également intéressant d'étudier la relation entre les nouveaux armements et le chômage: auparavant, on observait une réabsorption du chômage en période de réarmement. Aujourd'hui, en relation à la nouvelle technologie militaire, ce n'est peut-être plus nécessairement le cas. D'un côté, l'industrie de guerre emploie un nombre relatif d'effectifs, de l'autre côté, la compétition militaire provoquera peut-être la modernisation de l'appareil productif, par exemple, dans certains pays à économie planifiée, à la recherche d'une plus forte rentabilité de l'appareil productif pour soutenir l'appareil militaire (9) (donc, rationalisation de la production, et peut-être apparisation du chômage plus ou moins caché dans certains secteurs).

Par ailleurs, la compétition économique, pendant la crise - pour les ressources naturelles et pour la participation dans les changements de la division internationale du travail, ainsi que les conflits économiques et politiques concernant le choix de savoir si et comment on participe - engendre des pressions croissantes qui provoquent des conflits sociaux et/ou militaires à l'intérieur et entre pays du tiers-monde (10).

Mais quelle est la relation entre la formation et le chômage (11)? Dans la plupart des cas, cette situation se situe au niveau individuel et collectif. En effet, en analysant le niveau de formation des chômeurs, on s'aperçoit que la formation est relativement un rempart contre le chômage. Cette formation est donc une défense individuelle des fonctions de travail existant aujourd'hui seront influencées par les nouvelles technologies. Les secrétaires, les comptables, les employés seront largement confrontés aux nouvelles technologies, ainsi que les travailleurs agricoles et les ingénieurs (12).

On constate que non seulement le secteur des services est en train de se développer, mais que l'activité liée à l'industrie a aussi des composantes de plus en plus importantes de production de services: "l'organisation productive en devenir dépasse le cadre strict de l'usine et devrait être caractérisée par la prédominance de véritables systèmes organisés, mis en place pour remplir une fonction et offrir non seulement des produits, mais aussi des services" (13). L'organisation productive ne veut plus être limitée seulement au stade de l'usine; les implications pour l'éducation sont donc évidentes au niveau de la formation professionnelle, syndicale et sur le tas.

"Il est prévu qu'en 1990, la moitié des travailleurs dans les industries américaines seront des cols blancs spécialistes dans le maintien et le service des ordinateurs. Il incombe aux industries de recycler les travailleurs mis au chômage par des cours d'enseignement supérieur, ainsi que par des programmes soutenus par l'industrie. En plus, une agence appropriée devrait informer sur l'offre et la demande de travail, résultat de la production automatisée, dans tout le pays et assistée dans tout le transfert des travailleurs au chômage dans d'autres industries" (14). Le développement des robots produira en 1990 des robots "modulaires, précis, intelligents et capables de contrôle" (15) et, selon les prévisions effectuées par la Society of Manufacturing Engineers par la méthode Delphi, ils auront les caractéristiques suivantes: "Robots à composants modulaires standard: utilisation d'un bras multi-fonctions robots auto-propulsés; répétibilité inférieure ou égale à 0,001 pouce; utilisation de capteurs intégrés; utilisation de la reconnaissance des formes et de la rétroaction; utilisation de la capacité visuelle; robots programmables de manière interactive (16).

3. Nouvelles technologies et éducation permanente

Il est nécessaire d'amener l'apprentissage des technologies à un niveau symbolique, en gardant toutefois sa relation avec le concret", ainsi "élève devient le protagoniste et le contrôleur de son apprentissage, transformé dans un processus autonome de maturation semblable à celui de l'invention et de la recherche scientifique" (17).

Pour ce qui est du développement de la formation dans les structures productives, dans l'industrie, il faudra surmonter la résistance de certains cadres (qui craignent l'affaiblissement de leurs positions hiérarchiques), vaincre le scepticisme des travailleurs, qui ne voient généralement que les objectifs de la productivité et de la rentabilité de l'éducation) et transformer les comportements des dirigeants (qui redoutent parfois une mise en cause de leur pouvoir) (18). L'introduction des nouvelles technologies demande une formation de cadres dans la planification stratégique, la planification des innovations, la pensée systémique"...; il faut aussi "former les cadres qui ne sont pas concernés par l'introduction des nouvelles technologies"; "... il faut aussi continuer à former dans les compétences traditionnelles" et il ne faut pas oublier que les hommes et les "femmes non qualifiées sont plus vulnérables à l'introduction de la nouvelle technologie dans le lieu de travail" (19).

Mais le changement technologique n'est pas toujours idéal. "Les réductions de prix et l'augmentation de la consommation peuvent être un résultat, mais peuvent être produits à un certain coût. La nouvelle technologie peut appauvrir la qualité du travail et rendre routinier le processus productif. Elle peut engendrer la pollution de l'environnement. Elle peut déshumaniser le travail ou créer des implications sociales indésirables" (20). Le contrôle social de la technologie est peut-être le projet politique le plus important qui attend les sociétés contemporaines. Ce contrôle a des implications évidentes au niveau de l'éducation. C'est l'éducation qui peut contribuer à diffuser l'information qui peut permettre la participation des populations non seulement à l'utilisation de la technologie, mais à la définition des politiques concernant son utilisation.

La combinaison de technologie et praxolagie pourrait permettre une utilisation de la technologie plus cohérente avec le processus de développement d'une société (21).
L'éducation permanente devient une réalité dans plusieurs pays; l'élargissement du fait éducatif dans le temps et dans l'espace signifie nouvelles activités éducatives dans le cadre formel et non formel, dans l'éducation institutionnelle et dans l'autoformation. C'est peut-être la centralité de la connaissance et du savoir dans les activités productives qui détermine cette nouvelle importance de l'éducation. La nouvelle demande éducative se précise aux différents âges de la vie et en relation aux développements individuels et collectifs. Les institutions scolaires et universitaires de formation professionnelle, qui répondent en partie à cette demande, peuvent apporter une contribution, à condition que de nouveaux contenus soient introduits et que les enseignants soient en mesure de connaître et développer ces contenus.

Les modalités de l'apprentissage changent en relation à la multiplication des lieux et des temps de formation, de l'accessibilité ou non de l'information, de la multiplication ou de la rareté de la documentation, de la nature de plus en plus provisoire du savoir-faire professionnel, de l'évaluation continue des savoirs acquis par les individus au-delà de la formalisation par le diplôme. L'apprentissage s'oriente vers la solution des problèmes, l'acquisition d'une culture en mesure de renforcer l'équilibre psychique et l'identité culturelle, la maîtrise de la complexité de la vie quotidienne. Les nouvelles réalités sociologiques du savoir et de la formation sont peut-être à l'origine de la crise de la plupart des structures éducatives.

Dans la plupart des systèmes éducatifs, la réforme de l'enseignement secondaire est au centre d'expérimentations et de nouvelles législations. C'est la formation secondaire la plus déterminante en ce qui concerne les qualifications futures de la population. La relation éducation et travail concentre aujourd'hui beaucoup d'attention à ce niveau de scolarité et à cette période d'âge. En effet, le fait d'avoir négligé cette relation a amené dans plusieurs pays l'enseignement secondaire à accentuer le chômage des jeunes quittant l'enseignement secondaire avec ou sans diplôme. La réaction à cette défaillance a amené aussi à une réaction unidimensionnelle, qui anticipe en effet la formation professionnelle en réduisant l'indispensable formation générale. La réduction progressive des emplois dans le secteur industriel, dans plusieurs sociétés industrialisées, et le développement dans toute société du secteur des services, devrait faire réfléchir sur les modalités de cette formation liée à l'expérience productive dans la formation initiale et aussi, ultérieurement, dans la formation continue. C'est une réforme de l'enseignement secondaire combinant formation théorique et expérience productive, qui pourra permettre de réduire le nombre des chômeurs dans les sociétés industrialisées et surtout dans les villes des pays en développement, où le chômage des jeunes avec une scolarité secondaire avec ou sans diplôme est en train de devenir un fléau dramatique touchant souvent 50% de la population de cet âge.

La formation pour élever le niveau de l'activité productive demande aussi une ingénierie des ressources humaines au niveau régional et une requalification et un perfectionnement permanents des formateurs (22).

4. Expérimentation et innovation éducative

L'éducation demande aujourd'hui une expérimentation significative sur un plan conceptuel et une expérimentation qui soit bonne techniquement; cette dernière expérimentation nous permet de tester la validité des théories fondamentales et les théories auxiliaires permettant ainsi de préserver dans certains cas les théories fondamentales (23). Par exemple, l'évaluation de plusieurs projets concernants les relations entre éducation et travail pourrait permettre de confirmer l'importance d'une théorie pédagogique qui considère significative la relation entre l'éducation et la production, en séparant de cette théorie fondamentale plusieurs théories auxiliaires concernant certaines applications incorrectes de la théorie fondamentale.

Des innovations en matière éducative présentent des difficultés souvent oubliées. Premièrement, l'innovation demande une richesse d'informations et des investissements, ainsi que des efforts collectifs signifiant un travail commun pluridisciplinaire, et souvent interinstitutionnel; deuxièmement, l'innovation implique souvent la rupture des intérêts au niveau des structures sociales, économiques et ... éducatives; troisièmement, l'innovation signifie non seulement intuition, mais aussi gestion quotidienne de l'innovation. Peut-être ces difficultés pourraient être surmontées si les objectifs étaient clairs et les motivations individuelles et collectives assez évidentes. Mais les retards dans l'introduction de l'innovation éducative dans le processus éducatif sont souvent étonnants: des thèmes tels que éducation permanente, nouvelles relations éducation et travail, autoformation, éducation non formelle, nouvelles technologies et éducation, transferts des connaissances et de l'éducation ont attendu des décennies pour être introduits dans le débat éducatif et, ensuite, dans les politiques éducatives. Aujourd'hui, on en parle, et on passe de certains refus dogmatiques du passé à une acceptation sans critique. Il serait nécessaire de situer l'innovation éducative dans son contexte social, et d'analyser tous les obstacles, difficultés et oppositions aux innovations. Une stratégie de l'innovation doit prendre en compte aussi ces difficultés.

Des expériences éducatives décevantes, non seulement à l'école, mais dans d'autres contextes éducatifs, freinent des intérêts futurs pour l'apprentissage, et si l'éducation devient aujourd'hui une condition essentielle pour le développement, tout blocage par une évaluation sélective, par exemple, dans le processus d'apprentissage, signifie gachis des ressources humaines et, parfois, désespoir. Par ailleurs, la fonction reproductrice de l'évaluation scolaire en matière éducative n'a plus grande signification dans des sociétés qui sont souvent ouvertes et secouées par de nouvelles relations économiques internationales très dynamiques.

Le décalage des programmes éducatifs (scolaires et non scolaires) retient l'attention des sociologues dans les périodes de transition; certains (24) s'interrogent sur la sélection des programmes en relation aux nouvelles relations internationales dans le domaine économique et politique. Le décalage entre programmes scolaires et programmes indépendants reflète le décalage entre l'école et les autres structures (économiques, sociales, culturelles, et même éducatives) d'une société. L'adéquation des programmes des structures scolaires et universitaires aux programmes "demandés" ne devrait toutefois pas être mécanique, parce que cette demande ne correspond pas toujours aux besoins éducatifs en perspective. Dans leurs relations avec les activités productives, les structures éducatives doivent rechercher de nouveaux contenus de formation générale (logique, mathématique, linguistique et - pourquoi pas - musique, poésie), et non pas nécessairement anticiper des contenus de formation professionnelle dans une perspective à court terme.

Pour ce qui est de nouvelles technologies, les structures éducatives et productives devront être attentives à leur intégration cohérente avec les objectifs éducatifs et productifs. Par exemple, la division du travail entre l'homme et la machine se fera sur la base d'une analyse coût-bénéfice, en prenant en considération la supériorité de l'homme ou de la machine en fonction des différentes tâches. Si la machine est supérieure dans les vastes domaines des capacités de calcul, l'homme, par contre, a encore des avantages en ce qui concerne le codage, la mémorisation et la recherche de l'information concernant la mémoire à long terme, l'évaluation rapide et la catégorisation d'une information perceptive complexe, et certains aspects de la solution des problèmes, inférence et créativité (25).

Il y a des limites d'apprentissage concernant les machines. La compréhension de la parole continue hors d'un domaine très restreint demeure un but à long terme (26). Même dans les meilleures prévisions, les robots seront contraints dans le cadre de certaines limites pour ce qui est de leur possibilité d'absorbtion des commandes relativement sophistiquées. La division du travail et les relations entre l'homme et le robot ont des implications évidentes sur la formation.

In ne faut pas non plus oublier que "c'est toutefois essentiel de ne pas trop donner au concept de technologie, parce que ce n'est pas tellement l'évolution de la technologie elle-même qui stimule le changement positif sur un plan comparatif, mais la nature changeante de relations sociales qui détermine la nature précise du progrès technologique" (27).

Les innovations scientifiques et technologiques ne sont pas toujours une rupture avec les savoirs accumulés précédemment. Sur un plan pédagogique, il est souvent utile de mettre en relief aussi la continuité. Prenons par exemple les musées laboratoires qui cherchent à "conjuguer et intégrer de nouvelles et anciennes technologies; cette intégration est importante, soit pour récupérer les anciennes technologies - les savoir-faire qui disparaissent - soit pour donner aux nouvelles technologies une épaisseur historique et culturelle qu'elles n'ont pas encore" (28).

Les problèmes de gestion d'une société moderne, ainsi que ceux de l'institution éducative, sont aussi éducatifs; en effet, dans certaines sociétés, le décalage entre les découvertes et leurs applications est énorme. L'éducation peut contribuer à permettre la généralisation de nouvelles connaissances et une meilleure gestion des découvertes scientifiques du transfert technologique et de l'innovation en général.

Le dépassement de la crise politique et idéologique dans plusieurs sociétés trouvera peut-être son point de départ dans une recherche scientifique, sans a priori, des conditions dans lesquelles la science s'organise et se développe et des relations entre gestion, administration des structures et pensée divergente. L'intolérance vers la pensée divergente a provoqué et provoque des arrêts graves du processus de développement de plusieurs sociétés.

Les politiques éducatives pour la société de demain se joueront surtout au niveau des actions conjointes de recherche et de formation, de la libération des contraintes à l'apprentissage dans le lieu de production et de formation, l'élargissement des contenus tenant compte des dimensions planétaires de la recherche et de savoir (29). Pour ce qui est du savoir, il serait intéressant d'analyser, parmi les expériences de travail (dans les différentes structures productives agricoles, industrielles, de services, éducatives, culturelles) quelles sont les plus stimulantes pour son acquisition. Il serait peut-être décevant de découvrir que les blocages les plus forts se trouvent dans les institutions éducatives et dans les structures productives formelles (30).

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THE IMPACT OF TECHNOLOGY ON SOCIETY AND EDUCATION. THE BARBICAN EXPOSITION.

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That pioneer of Comparative Education in England, Michael Sadler, was alert to the significances to be deduced from national Exhibitions and Conferences. He has left on record how in the autumn of 1900, the Board of Education sent him to the International Exhibition in Paris with the task of reporting on its educational section. Characteristically Sadler notes:

> "A study of the Exhibition convinced us that is would be misleading to treat the section specifically assigned to Education, as if it were a separate thing in itself. The farreaching significance of much that was shown in the educational section only became apparent when the industrial and other departments were studied. It is natural that this should have been so, because education is not a thing by itself, but one aspect of national life and one of many closely-related expressions of national energy and intention.

How vividly those words came to my mind as I wandered around the extensive Hi-Technology and Computers in Education Exhibition, and attended its supporting Seminars and workshops, held at the Barbican Centre in London in January 1985! Here indeed was a manifestation of national energy and intention sponsored by the Micro-electronics Education Programme (MEP).

The origins of MEP is in itself an illustration of the impact that the new technology is having on society and education in the UK context. MEP was initiated in 1981, financed by the Department of Education and Science in England, Northern Ireland and Wales and administered by the Council for Educational Technology. The aim of the programme is to help schools to prepare children for life in tomorrow's technological world where the applications of micro-electronics will be ubiquitous. In addition, the programme seeks to help teachers to use the technology to stimulate learning in the children they teach. The 109 Local Authorities of the UK have grouped themselves into 14 regions. Each of these is served by an MEP Regional Information Centre from which is available a service supplying guidance about software, hardware, in-service training and curriculum development.

MEP also has national Co-ordinators to provide educational direction in the in-service courses and to keep regional staff informed about technological developments. In brief, through training and the dissemination of information, the programme seeks to make an impact upon society in the UK by helping to create social awareness and an understanding of the far-reaching implications of new technology for a rapidly changing employment situation. In its own technical language MEP's aim is stated:

> to help schools to produce children for life in a society in which systems and devices based on micro-electronics are commonplace and pervasive.

According to an official release of news, by early 1985 every school in the UK which wanted to buy a microcomputer with 50% funding from the Government would have taken delivery of its chosen model. By that time some secondary schools had had machines for four years or more and many primary schools would become beginners in using microcomputers as an educational resource. Obviously the entire schooling system is faced with adaptation to the spread of technological change.

The pioneers heading this change argue three clear and compelling reasons why electronics should appear in the curriculum of all pupils, and why, for some pupils, it should feature as a major subject of study. The Exposition at the Barbican Centre set out - very successfully - to present and illustrate these reasons which were crystallized as follows:

1. Micro-electronics, or New Technology, is increasingly pervasive in its influence on the world of work, leisure, education, the daily organisation of our individual lives and in the way Society is organised and controlled.
   Therefore, in a democratic society, all citizens should be well enough educated about the nature and capabilities of the New Technology in order to be able intelligently to influence its adoption, application and development.
2. A practical study of Micro-electronics has a very great deal to offer the basic educational process at all levels of ability and age. The subject is higly motivating because it is obviously relevant. It embodies a student centred practical approach which enables personal development in a wide range of skills, aptitudes and attitudes: particularly those of communication skills within working groups. It develops the ability to think logically, to learn and to apply knowledge to the solution of practical problems, to choose and implement a solution, to evaluate the solution, and, if necessary, improve this solution in the light of experience.
3. If Britain is to survive as a reasonably successful and prosperous nation, educators must be able to identify and stimulate those special pupils who have imaginative and crea-

> tive talents, and to encourage them to become the engineers and technicians of a successful manufacturing based economy.

Such were the arguments presented through the massive display in the Barbican Exposition. They raise a variety of fundamental issues in their implications for the impact upon, and response of, society in adapting its educational system. Overall the arguments reflect the contemporary pre-occupation in the UK, with a new emphasis on vocational education both at the secondary and tertiary levels. There are also implications of a selective process in the suggestion of identifying those special pupils - a suggestion evocative of what the pioneering comparativist Michael Sadler told an American audience in 1930:

> Education must produce an elite. The elite must emerge from the whole range of human society. How then can these two functions of education - the furtherance of a common interest and a fostering of an elite - be effectively combined?

A long-standing problem of the educational scene thus takes on a new form. If we are to have a selectivity of technological experts, they will have considerable power to influence mass conditioning of thought. There is an emphasis on communication skills and a demonstrable suggestion (as was evident in some of the seminars at the Barbican) of how the ability to think logically can be developed in specific situations. Again, as I observed in some of the workshops where practical demonstrations were given, I found myself recalling the old arguments that used to divide the psychologists about the transfer of training.

For comparative educationists the claim that the new technology is an instrument whereby to identify a problem and to choose to implement a solution, to evaluate it and possibly refine this solution in the light of experience, has a direct appeal because it echoes the methodology of an established school of thought in the Comparative Education field of studies. Generally MEP policy is careful to gear its arguments to the shaping of a democratic society in which it is assumed competitiveness will be a major dynamic. Britain is seen as being caught up in a world-wide competition of effort in which:

> We do not have any sensible choice. If Education does not play its role in this process then the future decline of our nation is assured.

In the UK the system of Further Education has long played a significant role in the development of vocational education. The Further Education service comprises the post-school sector with some 3 million students from the age of 16. In 1977 there was set up in the Department of Education and Science the Further Education Curriculum Review and Development Unit. Since January 1983 this body has become a limited company independent of, but still funded by, the Department of Education and Science, and known as the Further Education Unit (FEU). This agency had a stand at the Barbican Exhibition which revealed how from the faltering steps of those who first took a microcomputer into a British classroom there has grown what is now a discipline in its own right that has its application at all levels of education.

FEU has sponsored a wealth of publications such as Robotic Arms (July 1984) Computer Literacy (October 1984) Information Technology (April 1984) Framework for Action in Information Technology (July 1984). Other FEU sponsored projects include those concerned with college staff development for technology, word processing learning packages, financial modelling for small businesses using an open access micro workshop, use of computing and micro-electronics in science-based industry, and management and dissemination of information technology.

The impact of this new discipline has given rise to a number of concepts such as Information Technology (IT) and Computer Literacy. In April 1984 a pamphlet was issued by FEU entitled Information Technology in F.E. A survey of what is called 'the state of the art' in some twenty colleges is presented and, significantly, at the outset a section is devoted to the theme Information Technology - the Problem of Definition. Varying definitions are given including that by Unesco:

> Information Technology is the scientific, technological and engineering disciplines and the management of techniques used in information handling and processing their applications; computers and their interaction with men and machines; and associated social, economic and cultural matters.

The pamphlet offers a comprehensive survey, from which it draws 13 conclusions with their implications for future development. From the varying definitions FEU has adopted the following:

> Information Technology is the acquisition, production, transformation, storage and transmission of data by electronic means in forms such as vocal, pictorial, textual or numeric, such as to facilitate the interaction between people and between people and machines. It also includes applications and implications (social, economic and cultural) of these processes.

In formulating this definition FEU draws attention to the key words - data and the associated processes, people, machines, applications, implications.

Obviously this preoccupation with information reflects the explosion of knowledge that has taken place in contemporary society. It was impressive in the seminars and workshops at the Barbican Centre to see the enthusiasm and skill of young teachers as they demonstrated the use of computers as a resource and an aid across the curriculum in schools. At the end of it all I found myself thinking of Herbert Spencer's famous essay on the theme: What knowledge is most worth? Whose will be the responsibility ultimately to bring coherence and integration into the bewildering variety of information?

Another concept that has grown up during this onrush of the technological development is that of Computer Literacy. This is defined as the basis for the study of IT and it comprises:

a. An understanding of how computers work
b. An ability to use computer vocabulary
c. An ability to operate a microcomputer and an appreciation of what a programme is and why it works
d. An awareness of current trends in IT and its social implications.

As the interest in Computer Literacy grows there is the need for all teachers to attain some expertise required to introduce computer literacy into their work. This has considerable implications for teacher training programmes. Rather than a detailed knowledge of computer science, a flexible method of teaching is necessary so that opportunities in the classroom may be identified where computer literacy can increase the effectiveness of communication in practice. A Bulletin issued by FEU emphasises that:

> Computer literacy is a basic skill which all have a right to acquire. Thus all teachers should contribute to the acquisition of this skill in relation to the area of their work.

Reference was made at the outset of this paper to how Michael Sadler in his comparative studies insisted on examining the underlying forces from the social and economic context which influenced educational systems. It was clear in the Barbican Exposition that in the UK there is a new emphasis on vocational education manifesting itself, and that this is associated with the impact of economic and national issues. Indeed the organizers of the Exposition declared that they had set out to:

> demonstrate Britain's place in the forefront of microtechnology in education.

Generally the impression to be gained from the Barbican Exposition was of the inevitability of progress and the beneficial impact of the new technology. There was little evidence of misgivings about continuous progress such as have been voiced by the critics, for example, in reports such as those from the Economic and Social Research Council, in particular their study Information Technology and Education. In a series of papers published by the ESRC it is contended that there are:

> many serious flaws in the way Information Technology applications are being institutionalised in Britain.

The long term future of IT in the classroom seems assured but the critics suggest that much of the activity can be characterized as 'innovation without research'. Morley Page and David Smith, of the Southampton University Computing Service note the enthusiasm that has accompanied the early phase of hi-technology but they caution:

> A substantial edifice has certainly been erected in a commendably short time but its foundations are shallow and are in desparate need of underpinning.

They fear that there is a danger that mistakes made by the pioneers will be institutionalized by uncritical naïve users. There is an urgent need for teachers to be instructed, with computer-based IT devices at their disposal, how to design, develop and introduce entirely new techniques and learning environments. It is suggested that two lines of research are now called for.

One of these would focus on learning processes and IT, and look at the effects of IT on childrens' thinking and examine the process of heuristic learning, and find out how learning takes place when there are physical disabilities. The other major line of research should be of the curriculum and the information society. This would investigate what factors promote or inhibit the adaptation of IT by teachers: how curriculum change can be managed as the new techniques make their way into schools; and what influence is exerted on curriculum models by certain software styles and structures.

Dr. Edmund King, in a penetrating essay on Comparative Studies and Educational Reform, has articulated in a broader context, discussing the pressures for change and exploring new educational frontiers, the message that the Barbican Exposition was, in effect, sending out to the world.
He writes:

> The interfaces between national systems and internationally comparative considerations is more contentious than it has ever been. Moreover, the shifts in technological and educational emphasis between the era of heavy industrialisation and its

> associated commerce on the one hand, and the microprocessor world of communciations on the other, are full of profound challenges for comparative study, both of educational response as it actually happens and of projections for the future.

Dr. King, in thus emphasising the tasks and opportunities for comparative educationists today, draws attention to the fact that hardly any of the problems posed by the new hi-technology were recognised a generation ago when the foundations of Comparative Education as a serious discipline were established. He concludes with a signal which might well be heeded at this conference in its discussions of the impact of the new technology on society and education when he writes:

> Our comparative commitment must therefore be not simply lateral in some contemporary sense, but developmental and prospective too.

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Details of all FEU IT publications and current or completed IT projects are available from the Information Centre, Further Education Unit, Room 5/76, Elizabeth House, York Road, London S.E.A 7P.H. England.

Particularly helpful in compiling this paper for the Antwerp Conference have been the following publications issued by FEU:
- IT Bulletin No. 1 Winter 1984
- Further Education Unit July 1984 ISBN09464961X
- Electronics and Control Technology Domain published by the Sunderland Evaluation and Development Centre.
- Information Technology in FE. An Occasional Paper. April 1984 Information Technology and Education (School Government Publishing Co.), a report from the Economic and Social Research Council.
- The panoramic survey by Dr. Edmund King entitled Comparative Studies and Educational Reform can be found in Chapter 13 of Contemporary Issues in Comparative Education, edited by Keith Watson and Raymond Wilson, published by Croom Helm ISBN 0/7099/3607/9.

DIE TECHNOLOGIE UND IHRE AUSWIRKUNGEN AUF DIE ERZIEHUNG DER UNGARISCHEN JUGEND.

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In Ungarn fand die moderne Technologie - vor allem die Informations- und Kommunikationstechnologie - noch nicht überall Eingang und ist noch nicht bis zu allen sozialen Schichten durchgedrungen. Diese, eine der Hauptmerkmale unserer neuesten wirtschaftlichen, sozialen, wissenschaftlichen und kulturellen Entwicklung, ist aber heute schon eine vielseitige theoretische und praktische Tätigkeit, die auf die Einführung, Anwendung und Weiterentwicklung der modernen Technologie gerichtet ist. So kann man sich darüber kaum wundern, dass auch der Unterricht und die Erziehung, und die Schule in den letzten Jahren zu einem Bereich wurden, in dem man versucht, immer bewusster die Reihenfolge der Einführung der modernen Technologie zu umreissen, ihre Auswirkungen zu prüfen und ihre erziehungswissenschaftlichen Probleme zu erschliessen. Die Bildungspolitik versucht im allgemeinen durch die inhaltliche Erneuerung und ständige Entwicklung der Schule auf die immer stärkere und fühlbare Herausforderung der Technologie unserer Epoche - und noch konkreter unserer eigenen Entwicklung - Antwort zu geben. Mit grossem Interesse verfolgen wir die sich im anderen Ländern entfaltenden Vorgänge, und wir versuchen die dort formulierten Antworten, die neuen Modelle, die Resultate der Forschung, die Widersprüche und die Probleme kennenzulernen und zu prüfen. Das ist gerade die Stelle, wo die Untersuchungen und Wertungen der vergleichenden Erziehungswissenschaften nicht nur unentbehrlich sind, sondern äusserst viel helfen können. Um auf all diese Herausforderungen mit Erfolg reagieren zu können, muss man noch zahlreiche, recht komplizierte - darunter ganz neue - Probleme lösen.

1. In den Curricula muss man Verhältnis und Proportionen zwischen Allgemein- und Berufsbildung neu konzipieren. Es verlangt konkret eine neue Art vom Herangehen an die Stundenzahl der allgemeinbildenden und fachspezifischen Fächer und ihre inhaltliche Neustrukturierung (Integration) in den allgemeinbildenden Schulen. In den berufsbildenden Schultypen (Berufs-

schule, Berufsmittelschule, Technikum usw.) bedeutet es, dass der schulische Unterricht und die aussenschulische, betriebliche Ausbildung besser auf einander abgestimmt werden sollen.

In April 1985 trat das neue Bildungsgesetz in Kraft, welches für die kommenden 15 - 20 Jahre die Haupttendenzen in der Entwicklung des ungarischen Bildungssystems bestimmt. Demnach bleibt nach wie vor die Berufsbildung auf lange Sicht die grundlegende Funktion des Schulsystems. Diese Funktion ist gleichzeitig mit der allgemeinbildenden Funktion des Erziehungswesens eng verbunden. Aus der Sicht der institutionellen Bildung scheint es problematisch zu sein, dass die Kluft zwischen der sich immer umzustrukturierenden technischen Kultur und dem den Bildungsinhalt vermittelnden, traditionell wissenszentrischen und sich nur langsam verändernden schulischen Lehrstoffen infolge des immer schnellern Entwicklungstempos der Technologie in der Zukunft immer tiefer wird. Die Schule kann diesen Widerspruch nur dann verringern wenn sie den bisherigen - sich auf die mit steifer fächerzentrischer Anschauung zerstückelten Wissensmenge richtenden - Vermittlermechanismus der Überbringung der Kultur zu modernisieren fähig ist. In dem Bereich der Berufsbildung schafft die Bildungspolitik günstige Möglichkeiten und Bedingungen zur Anwendung funktioneller und tätigkeitsorientierter Annäherung. Wenn die dazu notwendigen Kraftquellen entsprechend den Entwicklungsbestrebungen konzentriert werden können, dann kann bei uns ein Tätigkeitssystem der heranwachsenden Generation verwirklicht werden, in dessen Rahmen die Handhabung der Informationsquellen und Informationsträger auf eine schaffende Weise angeeignet werden kann.

Die immer grössere Anwendung der von den Entwicklung der Mikroelektronik untrennbaren Kommunikationstechniken in den Schulen, die strukturierende Wirkung der Informatik beeinflusst die Gestaltung der Lehrstoffinhalte. Im Prozess der Vermittlung allgemeinbildender und beruflicher Kenntnisse ist die Verantwortung der Schule, die wirkungsvolle Aneignung der neuen technischen Kultur, die die ganze Gesellschaft umfasst und in den allgemeinsten Tätigkeitsformen erscheint, für die Schüler zu ermöglichen. In Ungarn entfaltet sich mit Erfolg von Anfang der 80-Jahre ein Entwicklungsprogramm, welches die Fundierung der Kultur der Rechentechnik für die heranwachsende Generation unter schulischem Rahmen zu verwirklichen gedenkt. Heute hat schon jede Schule der Sekundarstufe II einen Computer, und es entstanden bedeutende inhaltlich-methodische "Entwicklungswerkstätte" an der Basis der Schulen. Alles dies kann aber nur die erste Etappe der Modernisierung bedeuten. Auf gleiche Weise, wie es in dem Prozess der wirtschaftlichen Integration der Fall ist, werden wir an Hand der internationalen Erfahrungen in der zweiten Etappe Programme erarbeiten, die das gemeinsame technisch-wirtschaftliche Potential auf die Entwicklung von Mitteln konzentrieren, die wirksamer sind als die gegenwärtigen, und neue Perspektive auf die inhaltlich-methodische Entwicklung des Unterrichts öffnen können. Das Ziel ist klar: immer grössere Teilbereiche der Technik und besonders der Informatik sollen zu einem Bestandteil der Arbeit der Allgemeinbildenden Schule werden. Nicht mit den Einzelheiten der Fachwissenschaften oder mit der Informatik selbst müssen sich die Schüler beschäftigen, sondern wir versuchen in den Schülern eine Anschauung herauszubilden, die die vorkoppelung der verschiedenen Anwendungsbereiche der Informatik im Lernen und im Beruf fundiert. Das bedeutet, dass nicht nur die Schüler die Computertechnik erlernen müssen, sondern auch die Lehrer müssen für die Handhabung des Computers vorbereitet werden. Auf diesem Gebiet fingen schon die internationale Erfahrungen analysierenden und vergleichenden erziehungswissenschaftlichen Forschungen an, aber auch heimische Experimente werden durchgeführt. Heute ist die Mehrheit der Lehrer vom Computerunterricht abgeneigt, weil sie glauben, dass er die "Digitalisierung" des Denkens zur Folge haben kann und auch dem Wert des Schulsinns schaden kann.

2. Unter den neuen und veränderten Bedingungen und Anforderungen der Schule, des Lehrplans und der Methodologie, die sich in der Flut der Reformen des Schulunterrichts und der Erziehung entwickeln, wird es bestimmt unentbehrlich sein, die Inhalte der allgemeinbildenden Fächer zu modernisieren. Es ist aber auch klar, dass der Unterricht der naturwissenschaftlichen und anderen Lehrfächer, der neuen Technologie und der technischen Erkenntnisse, die allgemeinbildenden Fächer nicht in den Hintergrund schieben kann. Gerade durch die inhaltliche Modernisierung wünschen wir diese Fächer für eine bessere, wirkungsvollere Vermittlung der humanen Werte geeigneter zu gestalten. Es unterliegt keinem Zweifel, wie wichtig es ist den neuesten naturwissenschaftlichen, technischen und technologischen Erkenntnissen "Einzug" in die Schule zu gewähren, ohne diese Erkenntnisse würde nämlich eine neue Art vom Analphabetismus entstehen. Gleichzeitig werden die Funktionen der Schule unverändert beibehalten, die dazu bestimmt sind, für die Vermittlung der nationalen, europäischen Kulturtraditionen, und darüber hinaus sogar für die humanistischen Ideen und Werteder ganzen Menschheit zu sorgen. Gerade durch die wissenschaftlich-technischen Revolutionen, die neuen naturwissenschaftlichen und technologischen Errungenschaften und deren Ausbreitung wird eine Situation geschaffen, in der die Erkenntnis und die Aneignung moralischer, kultureller und humanischer Traditionen der Menschheit, und der neuen Bestrebungen und der Erfolge die

diese entwickeln, nicht nur für äusserst wichtig gehalten werden, sondern zu einer Schicksalsfrage der Menschheit, zu einer Voraussetzung und Garantie der menschlichen Schicksalsfrage, des menschlichen Daseins und des Lebens geworden sind.
Es ist offenbar dass die wirtschaftliche und soziale Entwicklung nicht notwendigerweise mit dem moralischen und geistigen Aufstieg, mit der Schaffung der Möglichkeiten zur Entfaltung und gemeinnützigen Aktivität, mit dem Zustandekommen des günstigen Makro- und Mikroklimas verbunden ist. Genauso erscheint das Dasein des Menschen, die Perspektive seines Schicksals in der von der modernen Technik und Wissenschaft geschaffenen Umwelt als eigener Fragenkomplex. Die Entwicklung schlug in unserer Epoche ein so stürmisches Tempo ein, dass die Menschheit gar nicht, oder nur mit Mühe, die Resultate verstehen und ebenso gefühlsmässig wie ethisch bewältigen kann; sie kann sich deshalb den neuen Voraussetzungen nur unsicher anpassen. "Unser Leben, schreibt der Physiker Werner Heisenberg, verlief früher einmal in einer natürlichen Umgebung, heute verläuft es immer mehr in einer von uns selbst geschaffenen technischen und mechanisierten Umwelt."
Würden wir diese neuen Strömungen nicht wahrnehmen, so wären wir dem Helden von Stendhals "Die Kartause von Parma" ähnlich, dem jungen Fabricio del Dongo, der als Sinnbild der Ahnungslosigkeit gelten kann. Er verirrte sich in die Schlacht von Waterloo, bemerkte aber nicht, dass er sich auf einem Schlachtfeld, im Mittelpunkt einer historischen Auseinandersetzung befand. In den letzten 15 Jahren des zwanzigsten Jahrhunderts begann eine Epoche, in der eine widerspruchsvolle Strömung von Kontinuität und Wandel, von Tradition und Neuerung entstanden ist, eine Situation, die am besten als Bewahren durch Abschaffen erklärt werden kann. War doch nach grossen revolutionären Umwälzungen und Erschütterungen - ja, man kann sie gesellschaftliche Kataklysmen nennen -, eine völlig andere, eine neue Wirklichkeit zustandegekommen, bei welcher nicht nur die Dialektik der Sehnsucht und der Möglichkeit und die des Planes und der Realität im Laufe der Entwicklung zur Geltung kamen, sondern oft genug auch die Hegelsche "List der Geschichte". Jetzt war es wirklich notwendig geworden, die Wirklichkeit zu entdecken und zu bewältigen, mit den nationalen und anderen Illusionen abzurechnen und das Erreichte nüchtern zu betrachten. Ohne dies konnte man kaum den Weg betreten, der weiterführt. Sobald die heftigen Zusammenstösse beendet waren, konnte - inmitten von konsolidierten, stabilen gesellschaftlichen Verhältnissen - an vernünftige, an durchdachte, aber auch an experimentelle Reformen geschnitten werden. Man musste der Gefahr des Provinzialismus, aber auch der des Beharrens an falsche Illusionen entgegentreten; die Welt, die Menschheit

veränderten sich und das brachte bisher unbekannte Probleme, Sorgen und Bedenken mit sich. Zu einer immer dringenderen Notwendigkeit wurde es, so etwas wie ein "planetares Bewusstsein" der Verantwortung zu entwickeln, in dem auch Angst und Sorge um Europa im Einklang mit einem vernünftigen, das Gemeinwohl fördernden Humanismus, zu worte kamen.

3. Eine Gutenberg- oder Videogalaxis?

Wenn wir gründlich die internationale Literatur der Erziehungswissenschaften studieren, dann können wir feststellen, dass die Sorgen und Resultate überall in Europa die gleichen sind:

1. Die Abstimmung der Unterrichtsinhalte auf die Anforderungen der Wissenschaften, der Technik und der Kultur.
2. Die Demokratisierung des Unterrichts und der Wunsch ihn offener zu gestalten.
3. Die Betreuung der Begabten, die Suche nach Begabten, die differenzierte Beschäftigung mit den begabten Schülern.
4. Die Gestaltung des richtigen Verhältnisses zwischen allgemeiner und beruflicher Bildung, die Ausbildung von disponibelen Facharbeitern und Technikern.
5. Auf dem Gebiet des Hochschulwesens die Durchführung gemeinsamer Forschungsprogramme, die Umwandlung der Universitäten zu nach Europa offenen Forschungswerkstätten und zu erreichen, dass die höhere Bildung im wahrsten Sinne des Wortes zur Ausbildung der Intelligenz wird. Gleichzeitig können wir aber über die Tatsache nicht hinwegsehen, dass sich die kulturellen Gewohnheiten auf die Wirkung der modernen Technologie hin in grossem Masse verändert haben. Man braucht nicht lang zu beweisen, dass der Bildschirm nicht in einem Masse die jungen Leute vom Lesem abbringt, wie dies früher die schwarzseherischesten Gesellschaftwissenschaftler vorausgesagt hatten. Zweifellos beeinflusst das Fernsehen die Freizeit und dadurch wird die Zeit kürzer, die man beim Lesen verbringt. Unlängst habe ich statistische Daten einer Untersuchung aus Ungarn und Finnland gelesen, die vergleichen wieviel Zeit die Leute in beiden Ländern bei verschiedenen Tätigkeiten verbringen. Diesen Daten konnte ich entnehmen, dass wir in Ungarn ungefähr soviel Zeit beim Lesen verbringen, wie unsere nordischen Verwandten dies tun. Es ist wahr, dass die verschiedenen Illustrierten in der Zeitbilanz der Finnen mit einem grösserem Gewicht vertreten waren. Das Gesamtbild zeigt auch so noch ein ehrenwürdiges mittleres Niveau. Besonders wenn wir die neuen technischen Mittel in Betracht nehmen. Infolge neuer Gewohnheiten ging auch binnen der Freizeit die übrig gebliebene Zeit, mit der wir aus dem

Gesichtspunkt der Rezeption der Kultur rechnen können, zurück. Zur Ausfüllung dieser Zeit kann man verhältnismässig leicht das Angebot der Unterhaltung, die keine grosse Kraftsanstrengung erfordert, für die Jugend annehmen lassen. Die niveauvolle Unterhaltung ist natürlich wichtig, aber man muss immer daran denken, dass man in dieser neuen Situation noch grössere Energie zur Verbreitung der Bedeutenden literarischen, künstlerischen Denkmäler und des humanistischen Erbes der menschlichen Kultur anwenden muss.

Es gibt Leute, die diese Auffassung mit dem Verhalten des aufgeklärten Absolutismus identifizieren. Ich bin aber überzeugt, dass keine einzige humanistisch gesinnte Kulturpolitik auf die Verbreitung der Werte und die Förderung und Stimulierung der Rezeption weder in der Gegenwart noch in der Zukunft verzichten kann.

Das Buch beansprucht keine komplizierten elektrischen Anlagen, kein Kurzschluss droht ihm. Ein Buch in einer fremden Sprache zu lesen und zu fassen ist viel leichter, als denselben fremdsprachigen Text auditiv zu begreifen. Das betrifft im Durchschnitte unsere Intellektuellen: die meisten von ihnen können fremdsprachige Bücher lesen, obwohl sie diese Sprachen kaum oder gar nicht in Sprechsituationen beherrschen können. Der Bildschirm ist einer gleichen Sprache mächtig, die überall verständlich ist, wie die Musik oder die bildende Kunst. Heute kann man den Videorecorder genauso "um-und zurückblättern", wie ein Buch, das rasende Bild kann auch abgestoppt werden, lässt uns also nachdenken, meditieren. Ja, was noch mehr ist, weil es den Menschen vom langwierigen Sammeln der Hintergrundinformationen befreit, gewährt diese Technik mehr Zeit und Energie für das freie Denken. Es ist auch eine Tatsache, dass die Kommunikation durch Bild nicht so aktive und kreative Mitwirkung von der Jugend verlangt, wie das Buch, der Text. Zweifellos bietet dabei die Videotechnik neue Möglichkeiten und neue Formen zur Entwicklung intellektueller Fähigkeiten. Darunter gibt es auch spielerische Elemente. Diese Fragen stehen auch bei uns zur Diskussion.

Oft und gewissermassen gerechtfertigt wird dem Computer vorgeworfen: es ist wahr, dass der Computer starke Motivation auslöst, weil die Kinder gerne mit ihm spielen, wenn sie aber nur des Spieles halber spielen, lernen sie etwas überhaupt, genauer gesagt lernen sie das und soviel, was und wieviel von der Schule erwartet wird? Steigt das Wissen der Kinder in der Proportion der mit dem Spielen verbrauchten Zeit an? Verwandelt sich diese Art von Spielerei nicht zu einem Spiel an sich, zu einseitiger Zerstreuung? Diese Fragen sind schon lange bekannt, aber sie werden heute immer mehr gestellt.

Sie werden aus der Erfahrung genährt, die wir bei der Anwendung der sich immer mehr verbreitenden elektronischen Spielgeräte gesammelt haben.
Es besteht auch die Gefahr , dass wir bei der Anwendung der Computer nur an Modellen arbeiten und bei der Mehrzahl der Schüler finden wir nur stimulierte Situationen. Wir können selbstverständlich die zukünftigen Geologen nicht ausbilden wenn sie nicht erlernen, wie die Gesteine richtig geprüft werden sollen. Zur selben Zeit ist es zu hoffen, dass die visuelle (durch Bildschirm) Vermittlung der Kultur auch dort das Interesse für Bücher erwecken kann, auch dort die Kultur für Lesen schaffen kann, wo sie noch nicht stark genug ihre Wurzeln fasste. Dies scheint eine Unternehmung des ungarischen Fernsehens zu beweisen, die vor Jahrzehnten ihren Anfang genommen hat und die zum Ziele hat, die besten Romane in Folgen auf dem Bildschirm zu zeigen und den Roman in Kooperation mit den Verlagen zu Beginn der Serie in mehreren Tausend Exemplaren auf den Buchmarkt zu bringen. Die Idee hat sich nach bisherigen Erfahrungen gut bewährt. Millionen schauen diese Fernsehserien an, darunter viele, die bis dahin kaum ein Buch in die Hand genommen haben, und das auf dem Bildschirm gezeigte Buch wird oft sehr schnell noch während der Ausstrahlung der Serie vergriffen. Letzten Endes möchten - und sollten - wir das erreichen, dass der eine der Wege oder vielleicht der verlockendste Weg der nicht oder kaum lesenden Schichten über die Videogalaxis zu der Gutenberggalaxis, aus dem "Weltsystem der Bilder" in jenes der Bücher führe.Die Kinder und die Jugend unserer Zeit - vom Erwachen an - wachsen in der Flut von Bildern auf. Die Bedeutung dieser Tatsache wird - auch bei uns - in dem Unterricht und in der Erziehung in der Schule erkannt und in Betracht genommen.

4. Als Folge der Einführung der modernen Technologie, obwohl es in der Erziehungswissenschaft noch um ein Anfangsstadium dieses Vorganges geht, sind schon in der Erziehung der Jugend manche negative und positive Auswirkungen zu beobachten. Unter ihnen gibt es moralische, kulturelle Umwandlungen in der Wertordnung, genauso wie auch soziale, psychologische, Generationen betreffende Probleme. Grosses Interesse erregen darunter die neuen Erscheinungen, Konflikte, Fragen, die "Lehrer-Schüler" und "Eltern-Kinder" Beziehungen zu beobachten sind. In Ungarn rückt dieser Problemkreis in den Forschungen im Bereich der vergleichenden Erziehungswissenschaft immer mehr in den Vordergrund.
Was die Probleme betrifft, die im Zusammenhang mit den durch die Anwendung der Elektronik und Computer angebotenen Möglichkeiten entstehen, muss das folgende gesagt werden:

a. Das Spiel mit diesen kann zu einer solchen Leidenschaft werden, die täglich sogar mehrere Stunden von den Kindern rauben kann. Es stehen uns konkrete statistische Daten zur Verfügung, die zeigen, dass einige Jahrgänge und Schichten 5-6 Stunden oder noch mehr täglich fernsehen, an Video- oder Computer spielen. Das ist aber in dieser Form und in diesem Ausmass auf jeden Fall negativ.
b. Die erzieherische Wirkung des Spieles und der Videoprogramme ist auch an sich widerspruchsvoll. Die an sich wertvolle Erkenntnisse bietenden, nützlichen, sogar ausgesprochen fördernden und erziehungswissenschaftlich und psychologisch fachgemäss gestalteten Programme rufen auch schädliche, agressive Instinkte wach.
c. Die Wirkung der Computer- und Videospiele, die die Geschicklichkeit, die Konzentrationsfähigkeit entwickelt und die Fantasie regt, die das Gefühl für die Technik und schliesslich die in der täglichen Anwendung der modernsten Technik erwerblichen Fertigkeiten entwickelt, gibt Grund zum Nachdenken. Diese Elemente sind nützlich und notwendig. Die Frage ist, wie man diese in den Dienst der harmonischen Entwicklung der Persönlichkeit stellen kann?
d. Der Personalcomputer und die verschiedenen Techniken in der Wohnung und deren Verbreitung werden allmählich zu organischen Bestandteilen der ausserschulischen Erziehung. Die Umfragen haben auch gezeigt, dass die jungen Leute früher in den Besitz eines Computers kommen und sich früher ihre Bedienung aneignen (sogar ein Teil von ihnen auch die Software anfertigung), als ihre Lehrer.

Was aber die erziehungswissenschaftliche Seite dieses Problemkreises betrifft, muss gesagt werden, dass die Erziehung in der Schule die Erziehung eines ganzen Menschen zum Ziele hat, keine Seiten vernachlässigen kann, angefangen mit der seelischgeistigen bis die körperliche. Weil die Aufmerksamkeit des Schülers durch das reiche Angebot der Medien (Bildzeitung, Film, TV, Radio, Video) in gewissem Masse geistig zerteilt, ist es die Verantwortung der Schule diesen Wirkungen entgegenzutreten umwillen der geistigen Einheit, der Oberflächlichkeit entgegenzuwirken, Werte zu verleihen und dem Schüler auf der Suche nach seiner "eigenen Wertzentrale" beiseite zu stehen. Die grösste Verantwortung liegt hier bei dem Lehrer, weil die technischen Mittel allein nicht ausreichen und garantieren, dass die Wirksamkeit des Unterrichts und der Erziehung besser wird. Die Hauptfrage ist, wie der Lehrer im Klassenzimmer mit diesem Geräten umgeht, und wie er fähig ist, die Erkenntnisse der Schüler, die sie ausser der Schule auf dem Gebiet der Informatik erworben haben, richtig auszunützen. Auf diese Fragen kann man nirgendswo auf der Welt eindeutige, auf ausreichende Forschungsergebnisse und Forschungserfahrungen gestützte Antwort geben. Trotz den heute noch offenen Fragen ist das aber sicher, dass wir mit der Hilfe der Informatik in Richtung nach unseren gesetzten Zielen vorwärtstreten können, wenn wir sie in einer durch die moderne erziehungswissenschaftliche Logik gerechtfertigten Weise anwenden. Die Präsenz und die Verbreitung der Informatik kann die Theorie und Praxis der Erziehungswissenschaft schrittweise umwandeln und die Schüler können weiter nach einer grösseren Freiheit des Denkens, dem Erwerb der Fähigkeit der Problemlösung streben.

Wir sind überzeugt, dass die Integration der modernen Technologie, der Informationstechnik und der audio-visuellen Technik eine einheitlichere Wertordnung, Intuition und Vorstellungskraft als heute in der Jugend unserer Zeit entwickelt. Wir sind überzeugt, dass sich die Zusammenarbeit zwischen den Lehrern und den Informatikexperten in der Zukunft stärkt. Um zum Schluss gestatten Sie mir eine subjektive Bemerkung: wir wissen wohl, dass "die Muse unserer Zeit die Technik" ist, aber eine Maschine kann den Menschen auch dann nicht ersetzen, wenn die weitverbreitete Anwendung der Roboter und Automaten die Entfaltung der Schaffenskraft der breiten Massen der Jugend ermöglichen wird.

MODELS OF VOCATIONAL TRAINING: ISRAEL AND SWITZERLAND AN ANALYTICAL AND INTERPRETIVE COMPARISON

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The educational systems of Israel and Switzerland at the post compulsory stage of schooling (tenth to twelfth school year) are remarkably different as far as student distribution between the vocational and academic sectors is concerned. In Switzerland most students (80-90%) at this stage enter into some form of vocational training and only 10-20% (depending on various cantons) attend academic high schools (Gymnasium, Lycée) leading to the matriculation certificate (Maturität/Maturité). In Israel the distribution of students between those two sectors, the vocational and the academic, is almost even.

But the difference is most remarkable within their vocational education systems. In Switzerland about 90% of the students engaged in vocational training are part of some form of apprenticeship, working with a master-tradesman in a plant or workshop, followed by part time (1-1 1/2 days per week) theoretical and general education in a vocational school. The other 10% attend full-time technical or vocational schools. While in Israel, 80% of those learning a trade, master it in full time vocational secondary schools and only about 20% are enrolled in some form of apprenticeship.

Indeed, the two countries maintain two different models of vocational training. They differ in aim, structure, content, responsibility, finance and control. The reasons for these differences are deeply rooted in their historical, cultural and socio-economic background. In Israel, a new and rapidly developing country which is absorbing immigrants, there were few skilled craftsmen who were able to train apprentices and to supply the skilled labour force needed by industry and commerce. On the other hand, the country is interested in minimizing the cultural and socio-economic gaps between the various immigrant elements in its population (of Asio-African origin and Euro-American) by providing secondary education to most of the youth. In Switzerland, the apprenticeship system is deeply rooted; most of the craftsmen were trained in this way. The senior craftsman is proud to instruct the young apprentice; the state and the public find apprenticeship the most proper way to train skilled workers as well as educate good citizens throughout the process of industrialization.

Thus, our study has shown that the two countries which are similar to some extent (both are small in area and in population, culturally diversified, lack natural resources, and are economically dependent on highly sophisticated industry and tourism), maintain remarkably different systems of vocational training. The two systems represent actually two alternative models: 1) vocational-theoretical (Israel), and 2) vocational-practical (Switzerland).

The aim of our study is to describe both systems, to analyse and interpret the similarities and differences in the light of the historical, philosophical, cultural, and socio-economic variables of Switzerland and Israel.

Vocational Education in Switzerland

The roots of the apprenticeship system in Switzerland can be traced to the Middle Ages (1). Presently, about 90% of the youth in Switzerland, who learn a trade, work as apprentices. Only about 10% learn in full-time vocational schools. Students in apprenticeship outnumber those in academic highschools 3 to 1. (Jahrbuch der Schweiz, 1973; OECD, 1975).

Vocational education in Switzerland is based on federal and cantonal legislation. This is the only educational framework regulated by the "Bund". It is left to the cantons to implement these regulations. The vocational education, in collaboration with the Federal Department of the Economy, the Federal Office of Industry, Arts and Crafts (BIGA/OFIAMT), and with various trade associations (Eggar and Blanc, 1974). The aims of vocational education in Switzerland are: "to train apprentices with the skills and knowledge that they will need to perform their duties as skilled workers; to provide them with general education; and to develop their personality and sense of responsibility". (Bundesgesetz über die Berufsbildung, 1972).

All apprentices, including pupils of full-time schools and of industrial schools, are obliged by an apprenticeship contract signed between their parents and their employer. This contract is a legal document which obligates the parties concerned and is mandated by the Vocational Education Law (Bundesgesetz über die Berufsbildung, 1972).

Graduates of all vocational education forms, who are holders of a proficiency certificate may be enrolled in schools for technicians, practical engineers, or foremen. This provision is of immense importance for the high status of apprenticeship in Switzerland. The "Bund" prepares curricula for the entire vocational education system. There is no difference between the curriculum for an apprenticeship school and a full-time school within a certain trade.

Apprenticeship is implemented in different forms: 1) regular apprenticeship - 3 1/2 - 4 days a week working in the plant or workshop and 1 - 1 1/2 days in apprenticeship-school; 2) combined apprenticeship-work in the plant or workshop, in school, and in concentrated practical course (block-release); 3) vocational middle school - 3 days per week working in the plant or workshop, one day in a school for apprentices and one day in a special school for general education; 4) industrial school - both the theoretical and practical lessons are conducted in the plant, or workshop; 5) a full-time vocational school - this school is also included in the apprenticeship system and its graduates are granted an identical certificate (Fähigkeitszeugnis) as they are also producing work while studying, and are paid a premium.

The system operates an elaborate counselling and guidance service, which is maintained both in the school's counsellor offices, and through exploration visits (Schnupperlehre) to plants, factories, and business establishments.

Teachers in the vocational education system are trained in technical schools, universities, and in teachers training institutes (2).

Vocational Education in Israel

In the early years of Jewish settlement in Palestine, several full-time vocational schools were established (Rieger, 1945). However, real development took place only after the establishment of the State of Israel in 1948, which was followed by an influx of immigrants and accelerated industrial development. This is reflected in the increase in the number of students in the full-time vocational schools from 2,000 in 1948 to 75,000 in 1979. (Educational Statistics, 1980).

Four different types of vocational education exist in Israel: 1) Vocational secondary schools (full-time); 2) Apprenticeship schools; 3) Industrial schools; 4) Short courses for youth. The first type is under the control and support of the Ministry of Education and Culture and the three other types are under the control and support of the Ministry of Labour and Social Affairs. These four types differ in their curriculum, duration of training, diploma and, most important, in the socio-economic background of their students (3).

Israel does not have a general and comprehensive vocational education law. The Apprenticeship Law of 1953 is concerned only with the apprenticeship system. There are several educational and youth employment acts but their regulations apply indirectly to vocational education (4).

The aims of vocational education are based on two philosophical approaches: 1) an educational-idealistic approach; and 2) a practical-materialistic approach. The Ministry of Education and Culture defines the aims of vocational education as follows: to prepare a skilled labour force for the needs of industry; to provide the student a general education in order to balance the technological approach with the general humanistic approach; to provide comprehensive educational opportunities by opening differential vocational education trends for different levels and aptitudes of students; and to raise the general educational level of youth as a vital means for social integration (Twenty Years of Vocational Education, 1968). The Ministry of Labour regards vocational education as a function of the labour force policy. It also aims to find the unemployed youngsters and rehabilitate them by social, vocational and employment means (The Department of Vocational Education, 1974). Thus, the rationale of both ministries is "practical-materialistic" as well as "educational-idealistic", providing both technical and social mobility.

The full-time vocational school system is divided into three tracks with different courses of study and diplomas: a) Secondary-Vocational - The proportion of academic studies to vocational is 60:40. Graduates earn a Matriculation Certificate (Bagrut); b) Regular-Vocational - The ratio of academic to vocational studies is 50:50. Students of this course of study are awarded a Final Certificate which does not entitle its holders university admission; they may undertake technicians' courses (grade 13) and in certain cases even engineering studies (grade 14); c) Practical-Vocational - This track teaches a vocation at a practical level and the academic-vocational proportion is 40:60. Its graduates are awarded a Certificate of Completion.

In recent years there is a trend towards the development of "Industrial education centres" (grades 11-12). Students of grade

11 stay 3 days a week at the centre for study and 3 days on the job in industry, while in grade 12 educational activities are assigned one day a week (Report for the years 1979/80-1980/81).

Full-time vocational schools are run by public voluntary organizations. Some schools are operated by minicipalities and very few of them by the government. But the Ministry of Education and Culture provides curricula, and is responsible for supervision, final examinations and training of teachers.

The second type of vocational education in Israel - the apprenticeship system - is within the responsibility of the Ministry of Labour and Social Affairs and comprises nearly 20% of all vocational trainees. Regular apprenticeship includes 5 days a week training in a workshop and one day of studies in school. There are new experimental apprenticeship projects in which students work for three days a week in a workshop and spend three days a week in school for apprentices where they receive practical and theoretical training and participate in special social activities within the community. The purpose of this experimental project is cultural, social, and occupational rehabilitation (5).

The third type of vocational education is the industrial school - three days per week in practical training and working in a plant, and three days of general education in the plant's school. Another variation of the industrial school is the inter-industrial school. This school is similar to the industrial school in which the apprentices work in different plants and study the theoretical subjects and general education together in a school for three days a week.

The fourth type of vocational education is one-year training courses in vocational training centres for adolescents (16-17 years old).

The schools for apprentices are operated by various public organizations, but the Ministry of Labour and Social Affairs covers most of the expenses. The Ministry pays one-third to one-half of the expenses for industrial schools with the balance carried by the plant owner and a vocational education organization. After completing the apprenticeship period, apprentices receive a skilled-labourer certificate, "Teudat-Miktzoa". This certificate does not entitle the holder to further studies on a post-secondary level. These four vocational training forms differ in their curriculum, in the scholastic performance of their students and in their socio-economic background.

Analysis and Interpretation

The comparison between the vocational education systems of Switzerland and Israel shows indeed the existence of two models. In Switzerland almost all vocational education is conducted through apprenticeship, while in Israel most vocational education is carried out in full-time schools. The reasons for this extreme difference might be that Switzerland has long possessed highly developed industries; vocational education developed in a traditional way; and young people were trained by master-craftsmen in their workshops.

Most master-craftsmen are convinced that it is their personal duty and pride to prepare a reservoir of skilled workers for the national economy. Educators in Switzerland feel that the apprenticeship system is the correct way to transmit vocational, social, and cultural values. The educational leadership of Switzerland claims that the country itself cannot afford to maintain a full-time vocational school system for all those who might be interested in vocational training because of the huge expenses involved in building up and maintaining such a system; the loss of thousands of highly skilled workers who will have to leave industry to become instructors would damage the country's economy (Brugger, 1975). Nevertheless, there are some tendencies toward change because more and more youth, after primary school education, are enrolling in academic secondary schools. As a result of this tendency, the academic level of the apprentices is decreasing. The "Federal Committee for Improving Apprenticeship" looked for ways and means to improve apprenticeship and to make it more attractive. Possible methods are: 1) to enlarge the vocational training middle school so that instead of one day per week, the apprentice will attend school for two days; 2) to enlarge the "combined training" (apprenticeship with concentrated pratical courses); 3) to open more courses for advanced apprentices in order to prepare them as foremen and for other leading positions in industry; 4) to expand the industrial school system; and 5) to expand the full-time vocational school system to complement apprenticeship and to achieve a better balance between them (Schweizer Blätter für Gewerbe Unterricht, 1974).

The reasons for the development of the full-time vocational schools in Israel are numerous. Israel does not have an industrial tradition since its industry is relatively young. There are very few master-craftsmen who have learned their trade as apprentices in plants workshops and are able and willing to train young people. Industry was developing at an accelerated pace and the demand for skilled workers was great. The Ministry of Education and Culture was interested in expanding the full-time vocational school system in order to provide learning places for those youngsters who would like to learn a vocation only in school, and not as apprentices; and to provide secondary education for the population of lower socio-economic status in order to minimize the cultural and educational differences and to accelerate social integration. Most parents in Israel wish to provide their children with a full-time secondary education and not to send children of school age to work, even through apprenticeship.

The apprenticeship system in Switzerland plays a dominant role in vocational training, enrolling youngsters of middle intelligence level. In Israel similar youngsters study in full-time vocational schools, which play the dominant role, while the apprenticeship system is training mainly boys and girls of lower intelligence level, children of Oriental (Asia and Africa) Jewish families, from lower socio-economic strata (Kahana and Star, 1973). The apprenticeship system in Israel is becoming a rehabilitation system and socializing agency for marginal youth, mainly of Oriental origin. The tendency of the Ministry of Education and Culture is to regard vocational education as part of secondary education, thereby giving more students the possibility of getting matriculation certificates. The tendency of the Minsitry of Labour and Social Affairs is to improve apprenticeship and to make it more attractive for youth who must, or prefer to, learn a trade in a plant, or workshop, and to provide unemployed youngsters with employment, training and education, thus integrating them into mainstream society.

There is a gap between the stated aims and the actual operation and achievements of the two systems. Vocational education in Switzerland, according to its stated aims, emphasises primarily the needs of the student rather than the needs of industry. In practice, however, the vocational education system in Switzerland is preparing skilled workers for industry with the training being carried out in the industry. The industrialists are very active in vocational training, supporting it financially and determining its scope and direction.

Theoretically the vocational education system in Israel, according to both ministries, intends primarily to provide skilled workers for industry. However, in practice, the stress is on general education. The major role of vocational education (in full-time schools) is to provide general secondary education to young people in order to accelerate social integration. The economic aim of preparing skilled workers is of secondary importance. As a matter of fact, the Ministry of Education and Culture is gradually reducing the number of hours in its vocational schools devoted to vocational training and enlarging the general education program.

Conclusions

This study has shown remarkable differences between the two vocational education systems of Switzerland and Israel. The differences seem to be of a paradoxical character. A relatively rich and developed country - Switzerland - develops an inexpensive vocational system - Israel - maintains a very expensive vocational education system (full-time vocational schools). Indeed, the two countries maintain two different patterns of vocational training. The differences are in structure, content, responsibility, finance and control, and in numerous other aspects. But the most striking difference is in the role and status of apprenticeship in the two countries. Thus, the two systems represent two optional models of technical and vocational education. The reasons for this phenomenon, as we pointed out in this study, are deeply rooted in the entirely different historical, cultural, and social backgrounds of the two nations. At this stage, it will not be advisable nor useful to attempt to determine which of the two systems is "better" or which of the two models is preferable. Both of them developed organically. Nevertheless, the development of an integrative scheme based on the best of the models, flexible enough to adapt to specific needs of various national systems, should be the sine qua non goal of all those concerned with the future of vocational education.

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Notes

1. Characterization of apprenticeship in Europe and its historical roots may be found in Magdenburg, 1959, and in Williams, 1963.

2. For a comparative description of teacher training in both countries see: UNESCO, Technical and Vocational Teacher Education and Training, Paris: UNESCO, 1973.

3. For further details and implications see Adler, 1974. A brief description in English of these various types, as well as a cost-effectiveness comparison of them, may be found in Borus, 1977.

4. The relevant acts are: I. Compulsory Education Act, 1949; II. State Education Act, 1953; III. School Inspection Act, 1969; IV. Youth Workers Act, 1953.

5. For details on this experimental program "Centers for Communal Apprenticeship", see Chaim Ben Yakir, "Apprenticeship Systems in West Germany and in Israel". M.A. Thesis directed by Yaacov Iram, School of education, Bar-Ilan University, Ramat-Gan, Israel, 1978.

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TECHNOLOGY, LABOUR RELATIONS AND LABOUR MARKET

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The theme chosen for this working group could also have been termed 'Technology and Society'. Instead, we have opted for the more limited 'labour relations and labour market', as it was felt that in work relations and in work that the implications of technological society and of the 'informatisation de la société' (the title of the leading French report on the issue, by Simon Nora and Alai Minc) will be felt most directly.

The first point that the working group would wish to take up is precisely this one. It can be argued that there are other domains that will experience the effects of technology more dramatically, such as that of the transformation of consumer behaviour, or that of transport, or that of 'medical' consumption. However, it would probably be unwise to dwell too long on this particular point. In all likelihood, the effects will be strong in all domains and there may be a good argument for centering on the work sector in view of the central position that it occupies in Western societies.

A second point that requires clarification is the term 'technology' in the particular context of the interaction between education and work. It is often said that after the 'technological revolution', the near future will witness the 'computer revolution' (the 'révolution informatique'). Its implications for the economy, for the labour market and for society at large are expected to be as far-reaching as those of the technological revolution, but they will come much faster and leave much less time for preparation. From an expensive commodity, available only to the elite of the business world and to central administrations, it is on its way to become an article of mass consumption, accessible to everybody and able to take over many functions in production, in the services and also in people's private lives.

It can be argued that the computer is more than just another technological achievement, that it means a fundamentally new way of dealing with the outside world, that it does not just allow to replace manpower but that it introduces a qualitatively different way of production, requiring from those involved a new way of thinking, new kinds of planning. In the same vein it is argued that working with a computer requires new modes of thinking, an entirely new relationship to information, qualities that young people seem to develop quite easily.

However this may be, the working group thinks it useful to define somewhat more closely what 'technology' means in the context of work and work relations.

The main theme that the working group has to consider is, however, that of the interaction between education on the one hand and economy, work and work relations on the other. Most educationalists would certainly agree that this represents a double challenge: education must prepare young and not so young people for this future and, secondly, it has a role to play in shaping it. In other words, it should not just react to current or predicted technological developments, but also attempt to affect their nature and course in line with its perception of desirable goals and values that should guide educational and social (but also economic) policies.

The first of these two dimensions corresponds to what manpower planning has attempted to do in the past - or what it should have attempted to do, i.e. to adjust the quantitative and qualitative needs of the economy. Most available forecasts of the implications of new technologies for the labour market are highly speculative and not of much help for educational policy. As a result of the lack of forecasts value-loaded views prevail. Or maybe, they should prevail, in view not only of the lack of precision of forecasts, but also because of the immeasurable social implications of the new technologies.

The workshop would probably not be able to bring together and analyse the very dispersed literature on this aspect of the problem, but a modest amount of stocktaking may be desirable in order to define tentative broad directions. Thus it would be very helpful some clarity could be obtained as to the kind of jobs that are likely to appear and the type of jobs that are likely to disappear as a result of the massive introduction of new technologies. It seems equally important to know, who at present occupies the jobs that may disappear, and who is likely to get those that will appear. The social and educational characteristics of these subgroups must be known for educational policy to be able to exploit this kind of data (or learned guesses, with regard to future developments). Men and women, school graduates with different patterns of achievement and perhaps with different personality characteristics, appear to be differently concerned and affected. (A question that comes to the mind in this context is, for example, who are the ones that most easily and effortless by become 'computer freaks'; what about the hypothesis that learning by computers isolates children from each other, has a-social effects?).

A second, equally important but much larger question is in what way work and work relations (and also work conditions) will be affected by the new technologies. There are work-external aspects to this: reducing working time, problems of control over and access to data ('Datenschutz') and the like, but also work-internal ones, related to the type of competencies and attitudes that will be required. If it is true that the 'computer age ' will require new ways of thinking, then this will affect work and work relations in the first place.

The second dimension of the theme, i.e. the role that education should play in shaping the technological future - and, for what concerns the working group, primarily the world of work in the largest sense - is probably even more difficult to handle. Certainly, there is a vast literature about educational objectives and priorities, but equally a low degree of consensus as to the personality characteristics that should be developed in children (or, perhaps, rather an abstract consensus that does not have very much effect on pedagogical behaviour). The present debate about 'quality' in education is revealing in this respect: The equality objective, after having been predominant in educational policies, has been virtually relegated to history. Similarly, competition between pupils has again become a virtue - and one that may be very useful in a future technological society.
It may help to study in some detail what objectives are being pursued by policy makers and educationalists in introducing computer technology in the curriculum and in making schools, teachers and pupils 'computer-minded'.
The theme of 'education and the new technologies' lends itself more than any other theme to comparative education study, because of the eminently 'international' origin of and control over the technological development. The sub-theme for the working group is even more relevant to comparative educationalists, as the developments in the world of work are even more dependent on international influences than those in other domains. Furthermore, the developed countries have taken up the challenge of new technologies for education in different ways and at different speeds. This should provide useful material for comparative analysis.

THE IMPACT OF TECHNOLOGY ON SOCIETY AND EDUCATION LEARNING FOR LIVING IN A MULTICULTURAL AND TECHNOLOGICAL SOCIETY

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The logic of learning for living in a multicultural and technological world assumes that individuals, society, technology and education are all in process of change at any given time. Moreover, the changes in these four terms are not necessarily taking place at the same rate nor in the same form. Thus, the circumstances attending the changes in individuals derive from the particular social, economic, political, cultural and educational patterns in any one society and within groups in that society.

By the same token the changes taking place in society derive in part from both internal and external forces, the combination of which determines the structure and function of that society. The national and international elements which enter into the shaping of a particular society are fluid and interdependent. The changes taking place in technology vary considerably from one social order to another and will also vary within any one society. Again, this technology may be rudimentary or sophisticated depending upon whether or not we are considering developed or developing societies. And as far as education is concerned the changes taking place in this domain must perforce, if they are to be effective, be in accordance with the changes in each of the three categories earlier defined, i.e., individual, society and technology.

Because change is the critical determinant in all realms of social, economic, political, cultural and educational institutions in any society, and because change is a constant in the growth and development of individuals and groups alike, and because the interactions which obtain between individuals and the aforementioned institutions are themselfve subject to change it follows that the logic of learning for living in a multicultural and technological society must accept change as a constant in the social order, this constant being the social process which describes the ways in which interactions take place between individuals and institutions.

The social process at work in both developed and developing societies takes as its basic premise that the social order in any society is a function of the relationships between individuals, that it is these relationships more than anything else that shapes the human environment. Thus, for example, while a developing society may still be depending upon oxen for cultivating its fields and a developed society may use a tractor, the difference in productivity will certainly be affected by the tools being used by these two societies, but though productivity will be affected by the difference in tools and consequent productivity, all else being equal, the human environment will also be affected by the extent of their involvement in their respective agricultural pursuits. Were there to be an exchange of tools, between these two societies, both human environments would be equally affected.

It may be assumed that in the aforementioned example the tools used were the most important factors shaping the person and his or her environment. However, when one takes in account the myriad other factors which go into shaping the environment, it is obvious that tools are but one of several elements in the equation. The quality of the soil, the seed, the work habits of the individuals, the use or misuse of fertilizers, the climate, all of these play their several roles in determining the succes or failure of their respective agricultural endeavours. Included, too, must be the hold which tradition has upon the individuals involved and whether or not they are disposed to adopt different measures for different circumstances. International aid programmes have demonstrated in too many instances that the provision of sophisticated tools to developing countries has not succeeded because old attitudes coupled with a lack of information resulted in abysmal failures.

Tools are an artifact of culture and whether these tools be robots or laser, computors or calculators, they remain tools in the sense that a hammer is a tool, as is an automobile. All are instruments for the extension and direction of the human will. Some of these tools are, of course, much more powerful than others, and as a result make it possible for an individual to exercise his or her will more effectively and efficiently. What this means is that as tools have increased the power of individuals to control and direct nature and man, there has been a comparable increase in the interaction between man and man and man and nature over a wider territory.

The communication system suitable for a collection of villages is not adequate for a collection of countries and where pigeons could in a bygone age provide speedy service over a limited number of miles in a couple of hours, satellites can provide global and interstellar services at the speed of light. Again, what we have here is a change in technology of communication which has impact on human beings. Critical to this situation however, is not the technology but its impact on people.

This impact is essentially a stimulant, a prod to human inertia, calling upon the person to forego established habits and handle much more information than before, be more selective as to the particular relevance of this information to the task in hand, and be better able to apply this information to whatever problem is in sight for examination. The impact of technology on individuals in different cultures will differ in respect of differences in custom conventions, laws, regulations, traditions, authority figures and in respect of the degree to which the progress from primitive to sophisticated tools has accomodated generational differences. The difference in the accomodation of changes by youth and adults is the difference which determines the direction of development in all societies, whether developed or developing. What this suggests is that the social process involved in accomodating an invention or innovation will be more a function of the individual and the group than it will be the particular tool that is being dealt with.

In the light of the foregoing it should be noted that learning for living in a multicultural and technological age is governed by the same social process that obtains in any age. What is different is the widening of the horizons of both the learning process and the parameters for living. The widening of the horizons of the village to encompass the globe at one and the same time widens the world within which the individual sees himself or herself living.

The basic principles shaping the social process are those of continuity, diversity, community, technicality, integrity, humanity, ingenuity, uncertainty and creativity. The learning process which determines the character of the individual in society is not only the acquisition of masses of information and the attendant skills necessary to use this information effectively, but it is the development of a disposition to see all of this in the larger context of the good of mankind, i.e. the context of the basic values which have moved mankind out of the caves of antiquity. Information, per se, and the accompanying skills may be used by individuals and for good or ill. The ultimate objective of learning for living in a multicultural and technological age is to learn to live in harmony with all of mankind.

The struggle between good and evil and between man and machine is an ongoing struggle which cannot be resolved unless the focus of attention is on man rather than the machine. Technology per se may be of use to man; the change is that man may be dehumanized by the machine in virtue of the power exercised by those in authority. We have had a number of examples of the way in which the thrust of science and technology have outpaced man's capacity to accomodate the innovations and inventions that have been developed. Automation and robotics have eliminated both skilled and unskilled workers resulting in the wastage of our human resources. The thirty-five million unemployed and in addition the underemployed in the western world as well as those in the developing countries indicates that the struggle between man and machine is in full swing and unless our educational systems develop programmes of study and strategies to prepare graduates for this struggle they will stand to be defeated. What we have here is essentially a classic case of the conflict and accomodation which attends social process, signifying the fact that any resolution must perforce derive from an active rather than a passive role on the part of all individuals and organizations party to the process.

The impact of technology on society and education is such as to recognize first that education is concerned with the question of "why" and technology with the question of "how" or "how best". In the light of these propositions the primary task of education is to prepare the individual to analyse a particular problem and conceptualize various solutions taking into account the relative variables that impinge upon the problem. Having done this the individual is in a position to use the appropriate technology to explore the limits of applicability of the various alternatives and, in the light of anticipated consequences, choose the most appropriate one consistent with the primary objective. In a world that is rapidly undergoing change in all dimensions of human learning and living, the ability and skill to solve social, economic, political, cultural and educational problems is paramount and hence points the direction for educational systems to take.

The growth in the population of the world is such that the peoples of developing countries will before long outstrip those of the developed countries. The science and technology which gave and gives the developed countries the economical and political leadership will in the long run be redressed by the developing countries obtaining this same science and technology and help them achieve the same social and educational benefits, with this difference, that the thrust of the developing countries will be to try to avoid the mistakes of the developed countries. Most of the developed societies achieved their economic supremacy in part on the basis of cheap resources obtained from developing countries. Today, the large corporations of the developed societies are transferring many of their factories to developing countries in order to exploit their human resources thereby creating unemployment in their home countries. It is this tendency for capital to exploit both natural and human resources that underpins their philosophy of the life of trade and commerce, a philosophy which is prepared to use anything and anybody for the sake of the continuity of their enterprise. So far as learning for living in a multicultural and technological world is concerned, the philosophy of capitalism is to place the human being at risk by giving the machine priority over man. This philosophy of capitalism is in reality a philosophy of power and to the extent that capitalism, communism or socialism or any other ism is concerned with power the same results will follow, i.e., the struggle between man and machine will be extended, differing only in degree.

In consequence, the role of education is to have as its goals the development of men and women who will be able to be masters of the machines which are invading the social domain, so as to make it possible to preserve the innate capacity of men to continue to be creative, constructive and capable of accomodating the changes which are inevitable in any growing organism.

Living organisms are the only entities in nature capable of independent growth. The sustenance necessary to promote this growth must be absorbed by the organism, though this absorption may be facilitated by way of various forms of intervention. Technology may be used to facilitate and enhance growth and to this degree is a valuable intervenor or asset for the learner. Nonetheless, the growth factor itself is stimulated in the learner by involvement in the experience of the race as expressed in courses of study and instruction and the associated literature. The learner's response to all of man's experience is conditioned by the particular culture into which he or she is born. Learning for living in a multicultural and technological society, therefore, calls for a much more broadly based and integrated educational system than has been the case before.

Learning for living in a multicultural and technological society calls for a system of education that is fully integrated, with the social order and functions as an integral part of it. The school can no longer be separated from the society that surrounds it, nor can those who serve as teachers within it, remain aloof from the day-to-day developments in that society. This means that educational systems must be organized so as to recognize that the educative process functions within social, economic, political, cultural and technological parameters that accomodate essential information and skills fundamental to determining the changes that range between social disorder and order, between the individual and the group, between national and international perspectives, and between dependence and interdependence.

The impact of society on technology and education, therefore, needs to be considered in the context of multicultural societies affected by technologies of various kinds, each capable of altering the mode and manner of particular ways of learning and living. By virtue of the fact that changes are constantly taking place in the social, economic, political, cultural and technological spheres at a rate that can leave school and its teachings out of date, it is essential for school and society to seek closer relationships. The integration indicated should take the form of establishing connections between the school and the relevant institutions in society in which it finds itself. Thus, elementary, secondary, and tertiary schools would each establish programmes of study in association with the social, economic, political, cultural, industrial institutions in their community. The social process units so developed would tend to keep school and society cooperating rather than competing for political attention exclusively.

This social process learning approach would contribute significantly to bringing school and society closer together as far as having a common set of objectives is concerned and at the same time help reduce the gaps which presently obtain between school and society, and between the rate at which the school changes and the rate at which society as a whole moves on its various fronts. The overall impact of the social process learning approach, applicable in all curricular areas, would go far to removing education from the sphere of partisan politics and return it to its rightful place in the consensus of the aspirations of all people in and out of school.

A world in which almost half of the people live on less than $400 a year, and in which the population of the industrial countries is a minority, is a world that suggests that the developed countries must share their educational energies and expertise in helping reduce the gap between rich and poor, between man and machine, and between learning and living. The one-world concept implies that the social process learning approach to living and learning facilitates the process of socialization as it affects both individuals and institutions on a global plane. The common denominator of man is man's involvement with his fellow men as they attempt to deal with their multicultural and technological worlds. And those worlds can only be mastered if schools work closely together with all of the community's institutions, industrial and otherwise. Integrated societies produce integrated men and women; men and women healthy in mind, body and spirit, capable of adapting to and accomodating change in all aspects of society.

THE IMPACT OF TECHNOLOGICAL CHANGE ON INDIAN EDUCATION

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India

The phenomenal expansion of knowledge, particularly in the fields of science and technology in the post World War II period presents both opportunities and challenges to twentieth century man. Though a major portion of the scientific and technological advances have been associated with the developed industrialized societies of Western Europe and North America, their impact has been worldwide. And countries on the periphery of a complex network of technological innovations, third world nations, in their urge towards rapid development have been eager consumers, - at times with little adaptation and sometimes with dangerous results, - of technological advances elsewhere.

Both the nature and pace of technological development are found to vary in the developed and the developing societies. Faced with the dilemma of limited resources and the rapidly multiplying demands on them, governments in the developing nations have perforce to lay down priorities regarding the provision of resources and facilities for research in the various areas of science and technology, as also for the adaptation and transfer of the latest advantages in these fields from elsewhere. To opt out of the scientific and technological changes taking place would no doubt be unwise. At the same time, in the transfer of technology the adaptation of 'high-technology' models per se would not bring the desired results in the developing nations. Just because a system is known to work in a highly industrialized society does not in itself guarantee that it would have the same desired result in a 'low-technology' society, unless it is adapted to the situation and the requirements of that society (1).

Further, the disparities in the nature and pace of technological change in the developed and developing nations necessitate that the problems and issues which arise in society in general and education in particular as a result of this change, are examined within each specific national context. Technological changes and innovations, whether in the fields of medicine, engineering, communications, physics or chemistry, give rise to the need for adaptive changes in other spheres, both institutional and attitudinal. The implications of technological change for society are numerous - in terms of making choices in politics, the optimum use for leisure, new roles for women, changed pattern of family life, nature and amount of work, the quality of the labour force, population size, and the impact of new media of communication, to mention a few. Equally numerous are its implications for education. Failure of the educational system to keep pace with the changing demands of scientific and technological progress has resulted in major inconsistencies both in education and in society, necessitating a reexamination of the knowledge, skills and values transmitted by a given system of education.

Within this broad theoretical framework, the paper examines the implications of technological development for structure and organisation of education in post-independence India. To bring independent India on a par with the developed societies, national leaders places their faith on scientific and technological development as the keys to progress. Nehru in particular was a strong advocate of technological development, the introduction of modern, mechanized industry, and fostering science and the scientific temper. In a society geared towards science and technology education has a crucial role to play in producing the quality and number of trained manpower required. In turn, technological development also contributes to the effectiveness and spread of the educational provisions. Two broad issues are thus found to emerge in the Indian context.

Firstly, technological change makes imperative a set of demands on the educational system in terms of its organisation and its curricular content, as well as in terms of the values, attitudes and beliefs which its fosters.
Secondly, technological progress offers alternatives in educational methods and techniques both for improving teacher effectiveness in the formal system, and for extending educational opportunities to sections of the population hitherto left out of its purview for, among other, socio-economic reasons. These twin aspects of the impact of technological change on Indian education are examined in the following sections.

I. The demands of technological change on education.

In a rapidly developing complex world physical resources of land and raw materials, being 'passive factors', are in themselves no longer the determing forces of development. The effective use of these resources depends on the corresponding development of the human resources - their levels and types of skills and knowledge, as well as their attitudes to development in general and work in particular. Education, being a major instrument for developing the human resources, namely, the human intellect, has to keep pace with the changing needs of a complex society. The magnitude of change required in Indian education is reflected in the observation of the Education Commission that "Indian education needs a drastic reconstruction, almost a revolution."

Two broad but related aspects of education needing urgent change can be identified. The firts concerns the organisational pattern and curriculum content, and the second the value system supported and transmitted by the educational system.

The Academic Bias in Indian Education

Commenting on the state of Soviet education in the late fifties, Krushchev in a memorandum to the Central Committee of the CPSU stated that "the chief and basic defect in our secondary and higher educational establishments is the fact that they are divorced from life." This was because the schools "are at present not accomplishing the task of training the young people for life, and are only training them for entering college."(2) This observation, with little modification can be applied to secondary and higher education in India.

The European tradition of a dichotomy between liberal education for the 'gentleman' and vocational training for the working class created a yawing gap between mental development and manual training, with separate institutions being set up, enjoying disparities of prestige, for each. During the colonial periode the English variety of the European model found its way in the content and organisation of Indian education, the curricula of secondary and tertiary education, including few if any practical subjects, and general education being separated form vocational studies. This model was reinforced by the idea of manual work being taboo for the upper castes and the glaring differences in the salary structures of manual and mental workers. Except for a few piecemeal and sporadic changes, this pattern has survived the colonial period.

In a period of rapid technological change when the economy needs not only technologists, scientists and administrators, but also technicians and skilled and semi-skilled workers, the academic bias of Indian secondary education has served little practical purpose apart from preparing students for university entrance. If secondary schools have served as mere "coveyorbelts" for entrance into higher education, the universities themselves, by concentrating on liberal arts courses, have been converted into 'waiting rooms' where the young school leavers spend a few years till they acquire a job. Overcrowding in universities, leading to a fall in standards, and an over-production of graduates, leading to educated unemployement and underemployment, have been the major consequences.

In a system dominated by a liberal arts curriculum, the requirements of the industry for middle and lower level technical personnel are largely ignored and the educational system produces workers whose training bears little relevance to the needs of the world of work. To match the outputs of the educational system with the requirements of a technological society, several changes in the organisation and content of education become necessary. In the first place, the training of high-level specialists and middle-level technicians functioning in a technological era calls for an increased emphasis in the school curriculum on education in the pure and applied sciences. At the same time, the curricular content has to be diversified to include alternatives to a purely liberal education in line with the needs of the economy, so that for a section of school leavers secundary education would be a terminal stage preparing them for various vocations and semi-professions. Further, with rapid technological change, the manpower needs of industry also undergo continuous change thus making it " necessary for most industrial workers at the lower levels to be retrained several times during the course of their working lives"(3). Together with rapid industrialisation, increased automation and the use of electronics have changed the nature and methods of work. Workers therefore need not only the skills in operating sophisticated machinery and equipment but also greater adaptability and willingness to continuously update their training. The necessity of continuous training to keep pace with changing technology makes nonsense of the notion generally prevalent in India that education is a process restricted to one period in an individual's life and that after he 'finishes' his education he begins his working life. The concept of education as something to be imbibed at one shot needs to be replaced by the concept of continuous lifelong education. Both attitudinal and institutional changes are required to make this possible.

The Challenges of Technological Change

From the above discussion it is seen that technological change makes certain distinct demands on the structure and content of Indian education. What are the challenges that these changes pose to the restructuring of Indian education?

1. Reforms in the organisation and curricula of school education.

As an education based on the principles of science is essential for an individual to function effectively in the technological era, the general education provided in schools would need to balance a study of the humanities and the sciences, with an increasing emphasis on the latter. Since the 1970s particularly, great emphasis is being placed on making science an important part of the school curriculum, and including it on a compulsory basis in the general education at the school level. To make this science teaching meaningful and effective calls for both a reorganisation of the science curricula and a rethinking on the methods of science teaching so that pupils are not only familiarised with the principles of science but also acquire a scientific temper. Whereas the first goal is relatively easier to achieve, the second depends on changes which go beyond curricular reform.

A second change required in the curriculum is concerned with maintaining a balance between general education on the one hand and preparation for a vocation on the other hand. In this context, the recommendations of the Education Commission (1966), which formed the basis of National Policy on Education issued by the government of India in 1968, bear particular relevance (4).

The Education Commission recommended a uniform pattern of education in which ten years of secondary education would be followed by higher secondary education, leading for some to a three year degree course. A major reason advanced for dividing secondary education into two stages was to diversify the higher secondary school curriculum and make possible selective admissions into the academic and vocational streams at the +2 stage. Recognizing the necessity to vocationalize secondary education, the Commission suggested working towards a target wherein, by 1986, 20 per cent of the enrolment at the lower secondary stage and about 50 per cent at the higher secondary stage would be in vocational and professional courses which would be terminal, qualifying students for employment.

In the 1970s the organisation of formal education was restructured in most states into a uniform 10+2+3 pattern, and the secondary school curriculum revised to provide full or part-time vocational education with general education for a small proportion of pupils continuing beyond class VII, and a separate vocational stream at the higher secondary stage to train middle-level personnel in various fields. Such a vocationalization of secondary education, it is hoped, would gear education to meet the manpower needs of a society undergoing technological change.

Finally, to reduce the gap between the world of work and the world of studies, and provide a much-needed corrective to the excessively academic character of Indian secondary education, the Commission envisaged a programme of work experience as an integral part of education at all stages. Drawing its inspiration mainly from experiments in Soviet schools, work experience programmes in India are expected to involve pupils in some form of productive work "under conditions approximating to those found in real life situations" (5).

The practical difficulties involved in the vocationalization of secondary education, such as the lack of resources and facilities as well as a dearth of trained personnel to teach vocational subjects, coupled with attitudinal obstacles to change have resulted in the policy being implemented effectively only in some states, and that too marginally, the numbers enrolled in the vocational stream (e.g. 12,5% in Maharashtra and 2.5% in Dehli) falling far short of the stipulated target.

The changing manpower demands in a technological era however make more urgent the task of combining general education with vocational training and making secondary education a skill-forming terminal point for some. The new educational policy currently mooted by the government concentrates therefore on examining the relevance of the curriculum to the world of work and suggesting a delinking of degrees from a great proportion of jobs. The success of these policies depends, to a greater extent than is perhaps realized, on appropriate attitudinal changes among teachers, students and parents.

2. Changes in the values and attitudes incalculated by schools

A study of attitudes is necessary to see how different groups in Indian society perceive the demands of modernization and development, and the changed role and concept of education in the process of development. In other words what are the attitudinal and value changes or modifications required in a technological society, and what is to be the role of education in bringing about these changes? An area of attitude change of particular relevance here is the realm of atitudes towards work. Two critical dichotomies, inconsistent with the needs of a technological society can be observed in the area of attitudes to work in India. The first is the mental work and manual labour dichotomy, and the second the predominantly male-female occupations dichotomy. Both these are related to the prevailing value patterns in other spheres.

Though the need for attitudinal change in the realm of work is often advocated, few studies are available in India concerning (a) the attitudes held by individuals towards work in Indian society and (b) the desirable attitudes towards work that need to be incalculated through the agency of education.

Work, as "an instrumental activity carried out by human beings to maintain or preserve life; directed at a planful alteration of certain features of man's environment" (6) requires not only a knowledge of what to do, and the skill of doing it, but also a 'mental-set' of attitudes for employing the knowledge and skills to the job at hand. What are these 'mental-sets' or attitudes necessary in a modernising complex technological society for the optimum utilisation of the available knowledge and skills? Values of cooperation, hard work, honesty and integrity, social responsibility, efficiency, discipline, achievement orientation and affective neutrality are some of the values found to hold special significance in the context of present day Indian society.

If the values and attitudes desirable in Indian society can be identified, schools, which transform 'playing children' into 'working adults', can serve to impart not only the knowledge and skills required, but also inculcate the values - both individual and society beneficial - required by the world of work. The task of retaining, modifying and changing attitudes needs to be taken up not only through the school curriculum, but more importantly through the atmosphere permeating the school and the approaches and behaviour of the teacher. A major aim of introducing work experience in the school curriculum was to inculcate healthy attitudes towards work, particularly manual work, and develop a 'sense of social commitment'. How far the 'hidden curriculum' of Indian schools has made possible the attainment of these objectives needs to be examined.

3. Changes in the aim and methods of teaching.

The present trend of including an ever-increasing body of knowledge and information in the Indian school curriculum needs to be arrested and even reversed for education to be meaningful. Indian education is at present characterised by excessive verbalism and a concentration on information transfer, which while overburdening the curriculum, leaves the teacher with little time to do anything else besides completing the syllabus. Under such a system pupils receive doses of information on various subjects, with little training on how and from where information may be acquired, how it can be tested and verified, and how it may be applied. The rapid explosion of knowledge and information technology makes a cramming of the school curriculum with facts and information both impossible and unnecessary. Apart from the fact that most of this information will be obsolete by the time a pupil leaves school, the growth of information technology puts at the disposal of the learner an efficient system of information storage and retrieval which he can avail himself of as and when the need arises.

This brings us to the second aspect of the impact of technological change on Indian education, namely, the use of technology in education.

II. The Use of Technology in Education

Technological change not only makes certain demands on education, but also makes available new materials and equipment, techniques, and instructional systems, all of which hold tremendous possibilities for education in the developing societies.

Although the teacher in the Indian classroom has had available visual aids to teaching, the development of technology in recent times now provide him with audio-visual, projected and electronic devices to assist teaching, and help make it more interesting and effective. Audiovisual technology, also known as educational communications technology, by employing "technical means for efficient storage and presentation of information and visual and auditory experiences" (7) enables a more efficient and effective dissemination of information, thus leaving the teacher with more time for interacting with pupils and giving them individual attention.

Erikson and Curl (8) identify the various roles which audiovisual technology can play in formal education as follows:
(1) extend human experience;
(2) provide meaningful sources of information;
(3) stimulate interest;
(4) guide student responses;
(5) overcome physical limitations of presenting subject-matter;
(6) stimulate problem solving; and
(7) provide diagnostic and remedial tools.

Despite the obvious advantages, lack of resources has put most audiovisual technology, particularly projected and electronic devices like motion pictures, television (both ETV and CCTV), video tapes, projectors, teaching machines, computers and the like outside the reach of a majority of Indian schools. Further, some local television stations regularly broadcast school programmes in subjects like science and English. The success of these programmes depends on the availability of teachers trained to write imaginative lessons, the provision of television sets in each school to receive the telecasts, and the capacity of the classroom teacher to supplement the televised lesson with preparation before and discussion after the telecast. In the absence of appropriate management skills on the part of the teacher, even well-prepared instructional T.V.projects cannot have the desired results (9).

Training in the use of educational technology therefore forms an important component of teacher education programmes today. With grants from the University Grants Commission many colleges of education have obtained audiovisual material for training prospective teachers in their use. As part of the programme of training teachers in the optimum use of the new technology, attention has also to be given to preparing the teacher to adapt to the new roles which the use of this technology requires. In the absence of such training, teachers may view technological aids as decorative, supplementary devices to be used sporadically. Also, the teacher training programme itself can be made more effective by the use of technological devices which facilitate simulation, role-playing, micro-teaching and interaction analysis.

Besides improving the quality of formal classroom instruction, audiovisual technology, in a society marked by unequal educational opportunities, can be harnessed to the task of widening the access to education. A feature of the inequality of educational provisions in India is the uneven distribution of schools resulting in glaring intra and inter regional imbalances in the provision of educational facilities. The use of technological media can help solve the problem of regional imbalances by facilitating distance learning. The Satellite Instructional Television (SITE) programme conducted during 1975/76 served to extend educational facilities to remote areas. With the launching of an Indian satellite the possibilities of spreading educational facilities are tremendous. For instance, from 1984 the University Grants Commission has started programmes in higher education which are telecast nation-wide through INSAT 1-B.

With technological change making continous education a necessity, and the increasing use of audiovisual technology in the process of education, the line between formal and non-formal education may soon become imperceptible.

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IMPLICATIONS OF TECHNOLOGICAL/OCCUPATIONAL CHANGE FOR RECURRENT EDUCATION

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Writing in 1976 (1), I emphasised that "Shifts in the occupational structure and its hierarchy imply re-learning and retraining and new relationships. Scholars now talk of the 'half-life' of professions (the time taken before the graduation package is half obsolete or only half complete) - five years in engineering, possibly eight in physics, five in medicine and so on. It was officially calculated last year that in the decade 1975-1985 there would be a 12 per cent job change in the European Economic Community. The figures do not matter so much as the obsolescence, with the need for 'recurrent education' in some form".

That was an under-estimate of the speed and extent of change. About 10 years ago (in 1975) it was generally accepted among experts that mankind's store of knowledge was doubling every seven years; now, in 1985, similar calculations inform us that the total of human knowledge is doubling every 2 1/2 years, and that by 1990 the multiplication of knowledge will be faster still - possibly doubling every year as 'fifth generation' computers already on display at Japan's 'Expo '85' in Tsukuba Science City seem to confirm. 'Artificial intelligence' is a serious study now.

Nor is mankind facing only the problem of ever-multiplying knowledge. Technological application of that knowledge brings profound re-ordening of industrial structure; re-location of industries and centres of communication or market power; re-instrumentation of the means of transportation and communication; transformation of the means of storing, retrieving and analysing information; new materials, new services, new life-styles; new relationships in family and social life; and, above all, acceptance of uncertainty in any preparation which school education and vocational training can make for the future.

In November 1984, OECD's Director for Science, Technology and Industry wrote in the OECD Observer, n°131: "Today we stand on the threshold of a new industrial era - an era driven by rapidly changing technologies and presenting major challenges and opportunities for strengthening economic growth". Among the major new technologies transforming the economies of countries and altering international relationships significantly he listed "electronics, telecommunications, industrial materials, production automation, biotechnology, artificial intelligence, ... the more specific fields of fibre optics, composite materials, CAD/CAM, robotics, etc. "(2). He might have added, of course, space technology, lasers in their multiple uses (including that of storing and transmitting information), and the 'dawn industries' only now taking shape in the world's experimental centres. It is significant that the most remarkable of these are to be found on both sides of the Pacific basin - in the Western United States, in Japan, and notably too in what are now frequently classified as the 'newly industrialised countries' or NICs - South Korea, Singapore, the Philippines, and of course the People's Republic of China.

Constant, accelerating change in "knowledge, technology, needs and tastes, commercial, industrial and financial practices" was also pointed to by the Secretary General of OECD in the OECD Observer n°132, January 1985, as marking " a period of rapid transition to what may be a new world-wide civilisation, shaped by the technologies now evolving with explosive speed", and accompanied by occupational shifts with personal mobility and adaptability.

It is very easy for us to forget how far we have already moved along the technological path during recent decades, and how quickly. Ten years ago word processors were still very new. Computers - huge machines of room size in the post-World War II period - have been reduced to microcomputers, whose sales are now greatest among children of school age and pensioners. Advanced word-processors and elaborate computers have been combined to enable Japanese printers not merely to print instant newspapers and books with the thousands of characters that their script requires by using a computer keyboard, but to speak to the screen and have the machine present a visual display of what has just been said, before setting the printer in motion. Indeed, the Japanese language spoken in this way can be instantly translated into English by the instrument for immediate printing or for world-wide transmission. It is said that the Chinese, too, are making rapid strides in the same direction.

Let us think of the pace of change in travel and communications - with their implications for all kinds of contact and human relationships. The first-ever jet air service began in 1954, yet in 1964 I was lecturing in Tokyo one day and teaching at King's College in the University of London on the following morning. Since then I have been to Japan for the weekend! Again, the first artificial satellite was launched in 1957; yet 15 years later there had been more than 500 Soviet satellites alone, and now telecommunications depend on such things as a matter of course. In 1969 the first moon-landing was watched simultaneously or on the next day by a quarter of mankind, and for the first time we all saw the earth from outside as a little blue ball covered with wisps of cloud.

Microprocessors now control many industries, and can regulate processes (and sometimes human responses) not only within single countries but right round the world. Few industries can now operate independently within the confines of one country: some of the larger ones (like aviation, electronics, motor-car manufacturing) by the multiplicity of their demands are necessarily international; and others which might seem to be locally based (like farming or retail shopkeeping) depend on international stock-exchanges and other regulations of enterprise. Indeed, it is a commonplace that the world's heavy industries have moved away from Europe and industrialised North America - and even away from Japan - to Korea, the Philippines, Mexico, and urban centres in half-developed countries. Meanwhile, a transformation both of these older industries themselves and of the relative distribution of work in the countries first industrialised is now accelerating the change from manufacturing to automation or robotics, and from "making things" to service occupations of increasingly sophisticated kinds.

Throughout the nineteenth and early twentieth centuries, school systems were more and more geared into the production of skilled manpower. Almost mechanically, they structured learning (and society) to serve the contemporary requirements of industry and its ancillary services. It is unnecessary to repeat here the impressive statistics of the changing balance between these sectors; but it is worth remembering, perhaps, that in Britain (for example) some 3 per cent of the work-force is sufficient to produce more than half of what the country eats, while in the United States less than one-third of the work-force is engaged in the industries turning out such a flood of manufactures. In the OECD, all member countries except Greece and Turkey had more than half of their work-force in 'services' in 1983 and many had approximately two-thirds so employed (3). Those two year old statistics are the latest oficially available in March 1985; but informed calculations of trends indicate even greater swings away from the kinds of occupation for which a reasonable secondary school education would suffice towards those which demand a sound basis fo higher education, followed by in-service updating if not reorientation. Re-education is now necessary in many professions. It is taken for granted now that in addition to the new industries constantly emerging, and to those whose internal shape and external relationships are evolving fast, the next decade or two will produce many more industries at present unknown. Or at least, many occupations at present unknown. Technological change so far has produced as much employment as it has displaced. However, the hierarchies of employment are far

from being the same as previously. The older venerable professions are neither as highly regarded nor as relatively well paid as before, wheras some of the newer types of occupation (in 'communications' especially - including 'public relations' and selling things or finding markets and influence) enjoy high public esteem and publicity. Television, which itself began as a public service only in 1936 and which was available only to a tiny minority at the beginning of the 1950s even in industrialised countries, quickly captured the masses during the decade. Now, combined with teletext and microcomputers, it dominates many homes and is a tremendous power in the schools of all advanced countries. Even at home, children spend more time with television than they spend in schools; but when we add into our calculation the televised or distance-delivered learning available to schools and colleges of every type (not to speak of libraries and other documentation centres) we have to acknowledge how vast a change in educational prospects and requirements has come about through the multiple services of the communication industry.
Consequently, there has been a shift in the hierarchy of learning and in the motivation impelling learners to undertake particular kinds of study. Moreover, the previous importance attached to much memory-work, mathematical dexterity, and the like, has vanished now that we have instant recall of many details and instant calculations to short-circuit much laborious work; therefore the tedious martyrdrom of so many school exercises and so much homework is of no more apparent virtue than calligraphy or weight-lifting - since much of it is certainly unnecessary. The school subjects which have come to the fore in popular choice as well as in official plans for educational improvement are no longer the classical champions of the curriculum but mathematics and the sciences - and, in many countries now, 'craft, design, and technology' as well as the imaginative activities of school life. Much advance now depends upon alternatives and adaptability in learning.

Since these changes - though important - are little more than detail of structural change within the curriculum (often accompanied, of course, by structural changes in scholastic institutions, in the teaching profession, and in the relative importance of qualifications), let us move on to consider generic and contextual changes affecting the schools and the outlook from them. To be frank, for most people the advantages of schooling have been measured in terms of improved job prospects. Advanced certificates and degrees from universities could be counted on to lead to distinguished - or at least comfortable and well-paid - careers which would be enjoyed in permanence, and often with social privilege. Now that expectation has been transformed, and often shattered.

It seems strange now to look back twenty years on the 1960s. That decade began with confident expansion - in education as well as in other investments for the future. Major industrial and commercial enterprises indulged above all in 'planning', drawing up schemes of continuous development and expansion for ten or twenty years ahead. During that period 'the economics of education' was invented as a serious, scientific study - but more as a branch of 'manpower planning' than as a matter of thrifty cost-effectiveness (as it has now become). Schools and colleges seemed part of a manageable - indeed predictable - vista of input-process-output sequences. That vista was a mirage that has faded. The human element of choice was ignored until student reaction in the USA and Europe (East, as well as West) surged enough to make governments tremble. In any case, 'prediction' was shown to be little more than presumptive guesswork (4), based upon factors arrogantly ignored or upon false assumptions about how educational systems really worked and how employment really made use of education's output. Elsewhere (5), I have pointed to the central importance of judgement in influencing the way educational systems respond to people and circumstances but often circumstances alter in unpredictable ways, especially in consequence of world trade upheavals, wars, and technological reorientation.

All these points of challenge to educational complacency seemed to come together in 1973 - so much so that many people supposed that the 1973 crises in petroleum prices and finance (since the price of oil and energy increased fivefold) brought about the 'crisis in education'. That idea was grievously mistaken. The crisis had been visible for a decade or more. Secondary education of some type had become universal in industrialised countries; and full secondary education to the age of about 18 or 19 had doubled its post-compulsory enrolments, or in some case trebled them, until the great majority in most advanced countries embarked on post-compulsory education. Enrolments of over 90% were reached in Japan, over 80% in Sweden and the USA, over 70% in Norway; and in all the countries of North and Western Europe except Britain, Ireland and Portugal more than half stayed on for full-time education and training beyond the age of compulsion. As it happened, those were also the years when the post-war 'baby boom' was sendig teen-agers through upper secondary and higher education. As long ago as 1958 the so-called Khrushchev reforms in the USSR had attempted to cope with a similar flood of aspirants for continued study by introducing new elements of work-oriented preparation and periods of work-experience, so as 'to bring the schools nearer to working life'; and the 'student unrest' from about 1964 onwards in the USA was prompted by unease about the relevance of protracted tutelage to contemporary conditions and ultimate job prospects. A similar state of disquiet among post-compulsory enrolments in five representative West European countries was thoroughly documented in a 3-year research programme (6), long before statesmen and planners got down to worrying about 'the transition from school to work'. Those students were more alert to problems of their teachers and elders.

Nevertheless, the 'transition from school to work' did become a major preoccupation, for two reasons: (a) both the academic type of education and the vocational/technical types of training currently available were ill-adjusted to contemporary industrial/technological requirements - let along those of emerging types of employment; and (b) the international collapse of trade and the re-location of manufacturing industries (within countries, as well as internationally) left many school leavers with little prospect of employment locally or in the types of occupation which they had quasi-automatically assumed would be theirs. In one country after another, and in international agencies such as OECD, the European Communities and the Council of Europe, a large volume of reports appeared on the problems of 'transition'. Many of these were primarily concerned with the problem of growing unemployment, which increased rapidly among all age-groups in industrial countries after 1973 - but most especially among young adults under 25, and above all among people between the ages of about 15 and 20. Young adults in the 15-25 age-group make up some 40% of all the unemployed in industrialised countries, while those under the age of 20 are three times more likely to be unemployed than the 20-25s. Furthermore, the average length of employment (if obtained) is about six months on average in industrialised countries, alternating with unemployment of similar duration, itself very often followed by a changed type of occupation. In low-income countries the employment prospects of school leavers and higher education graduates are even more precarious. Thus, the 'transition from school to work' is extremely uncertain.

Faced with growing unemployment among young adults, many countries have initiated 'youth training programmes' which in many instances are little more than palliatives for unemployment statistics. Sometimes they are well-intended, of course, but in the present state of the job-market Britain's present figure of about half of the trainees finding jobs eventually is about average. Many, however, do not find the jobs for which they have been trained under emergency schemes; and throughout the world at present the jobs which young adults find are being gradually depressed in status and pay because of the glut of young 'employables' - and also because really worth-while jobs now depend on more advanced and different training. Unemployment is therefore being caused or aggravated by two factors: structural change (including the re-location of industries, take-overs, obsolescence, and being superseded by new industries); and changes of character because the different work being done requires different competences and therefore different forms of schooling. Linked with the latter requirement is the need for constant updating, with adaptability to readjust oneself and one's skills. That all means in-service re-education; and for that, in turn, a different kind of preparation is required during earlier school years.

It is customary among professional educators to focus attention almost exclusively on schools or college of one type or another, and to think of 'youth' or 'young people' as people distinct from ordinary adults. On both these counts they are out of touch with the times. In the first place, many adults whose schooling was foreshortened or inappropriate now need (and wish) to return to education or training at 'young adult' or immediately post-compulsory levels after varying lengths of time away from formal schooling. Among these 'returners' are many whose former employment has been wiped out by take-overs or plain obsolescence; there are also many women who now seek employment and therefore training because their families have grown up and left home, or because their marriages have broken up; and, of course, there are many who need to 'top up' or 'make a fresh start' either because of personal ambition or because they simply must retrain to meet the requirements and opportunities of new technologies.

Therefore the whole field of 'post-compulsory education' - which was a new term (or at least a term with new significance which needed explanation) (7) when my colleagues and I focussed attention on it in 1970-1973 - now appears as a modern theatre of new-style experiments in education at a characteristic level for any adults beyond the level of basic schooling, but before full specialisation for a detailed graduation course or a defined career. One might loosely refer to it as a span of learning and/or training 'from 16 to diploma level'; but in today's and tomorrow's circumstances it is important to recognize that the age of participation matters for less than the level of need served. 'Returners' and those who wish to 'round out' their personal profiles of learning and competence were also served. Indeed, already more than one-fifth of those enrolled in Swedish '16 to 19' provision have been out at work and come back in. Technological/occupational change, changes of mind, and the ever-obvious need to prepare for uncertainty ahead seem to establish 'post-compulsory education' in a central position when plans are laid for future provision.

Already existing structural innovations (such as new-style lycées, the Kolleg in some parts of the Federal Republic of Germany, Norway's gymnas (8), and the 'tertiary colleges' and 'sixth form colleges' in Britain) call for careful consideration, for several reasons: (a) they are separate from ordinary school at a time when new laws, advertisers, and self-awareness have all helped to bring fuller recognition to the over-16s as really young adults, and (by being evidently concerned with educational and personal provision for sexually and socially mature people rather than for 'conditionally relevant' trainees) they have developed a new ethos and appropriate teaching/learning relationships; (b) their increasingly comprehensive character makes it possible to combine different subjects, different levels of study, and different career prospects in ways which were previously impossible; (c) their links (structural or personal) with work experience outside add a new dimension of relevance and experiment; (d) provision is often made for 'returners' to resume study at this level - no matter what their age. The last feature is particularly noticeable if the 'community college' aspect is developed by evening provision, or by deliberate fostering in other ways.

If, then, we recognize that post-compulsory education is really the first phase of adult or lifelong education, that it often implies a 'fresh start', that it always entails fresh teaching/ learning relationships, we see that it is pivotal in two ways: it turns our attention positively to the long vista of recurrent education of every kind, with multi-media support in a great variety of learning contexts; it also points to the futility of trying to pack a portmanteau of knowledge and skills for life during the basic years of school. Instead, basic preparation must be given for continuous learning, continual reappraisal, and continuous participation in the responsible process of adding to knowledge and judgment instead of merely receiving what is handed out.

Especially (but not only) in this connection, it is important to consider the extent to which 'noneducation' agencies participate in recurrent training/retraining. Many of the initiatives of 'youth training schemes' already mentioned have brought Ministries of Industry or Employment (rather than Education) into large-scale and potent intervention in the 'Education' field - and not only for those beyond compulsory school attendance. In fact, some dissatisfaction with the prevalence of 'academic' or 'bookish' programmes in upper-secondary classes has caused many teachers as well as pupils to welcome more work-related studies and 'real life' presentation into the schools of many countries, particularly for the over-14s. However that may be, there are many implications for varied and long-term experiments in the follow-on from compulsory schooling. Different styles of teaching/learning, with input from the media and computer-assisted delivery in particular, combined with new ideas about the best ways of providing for adult and recurrent education as and when needed (in alternative locations and with 'intermittent' or discontinuous timing) now call into question the 'school-type' norms for any educational communication to young adults - and, of course, older adults.

Whereas earlier studies of the educational needs of 'youth' seemed to focus on a supposedly transitional stage, or on 'young people' who did not quite fit existing scholastic and social expectations, it is now clear that 'young adults' represent the normal if not normative educational situation of the majority of mankind. In the past, most educational prescriptions concentrated heavily on the supposedly innate abilities and permanent competences of the minority; but we are now in a situation where the average young adult is in full-time post-compulsory education and/or training in industrialised countries. Nowadays, even specific training must take on a 'provisional' character because of inevitable technological changes. It requires a more educative element than previously so as to facilitate adaptation to change. Many of our plans for the future (which must take account of the fact that the newly industrialising countries may be starting now in closer consonance with the requirements of rapid technological and social change than the existing proto-technology of education has ever envisaged) will therefore benefit if we learn from the perceptions and experience of young adults who are on the very frontiers of a 'third technological/educational era' (9).

Space does not allow detailed examination of some outstanding changes in today's technological/occupational reorientation; but the crudest and most important indication is plain. As long ago as 1926 A.N.Whitehead in Science and the modern world said: "The fixed person for fixed duties, who in older societies was such a godsend, in the future will be a public danger". Quite apart from the 'half-life' and obsolescence of already acquired professional expertise already referred to, we now have to remember that there are many people among and around us who have the potential for the new roles and new sciences or technologies which the future will demand, but who so far are retained by present technology in a state of latency or incompleteness. Why should technicians not aspire to become top scientists or technologists? Why should nurses and paramedical personnel not proceed further? Why should those with social and human skills urgently needed not be enabled to enrich them with supportive studies - and not only in Open Universities or open colleges but by a multi-media array of opportunities? The technological network of opportunities in a 'communications society' - and the demands of the occupational revolution going on under our eyes - make such reconsiderations essential.

For similar reasons existing courses for higher education and training are now 'modular' and open for access according to personal readiness, although most established systems of professional qualification and most university systems continue to resist the obvious implications. We should be prepared in many walks of life to accept the idea of "two-tier" or "multiple-stage" qualifications - both to suit personal states of readiness or convenience, and also to serve technological/occupational requirements as they emerge. Whereas in the past the 'continuous' and sequential model of learning had prevailed (often simply as a means of excluding large numbers of aspirants from jealously garded professions and institutions by eliminatory examinations) tomorrow's occupational patterns will require successive recruitment, multi-level entry, and recurrent education for all.

Education for uncertainty (10), or for a continually moving frontier relationship with learning, is already becoming characteristic of a 'communications society' in which all learn and all teach in some measure all the time. Our youngest children will inherit such a world. Young adults are already on its doorstep. Some are already undergoing new kinds of education or training adjusted to it. In any case, questions of education and recurrent education for technological and occupational change - and the social implications of these things - are central to realistic policy-making for education everywhere.

Notes

1.
Education for Uncertainty: an inaugural lecture in the Faculty of Education at the University of London, King's College, 1976, p.11.
2. OECD Observer, N°131, November 1984, p.3.
3. 'OECD Member Countries', in OECD Observer, N°133, March 1985.
4. L.Cerych, 'The certainty or uncertainty in higher education', in E.J.King (ed) Education for Uncertainty , 1978, pp. 71 and following.
5. See E.J.King, Comparative Studies and Educational Decision, 1968, especially chapter one, 'Is there a science of educational prediction?'.
6. Fully detailed in E.J.King, C.H.Moor and J.A.Mundy, Post-compulsory Education I - a new analysis in Western Europe (1974) and Post-compulsory Education II - The way ahead (1975).

7. E.J.King, Post-compulsory Education in Western-Europe - A new concept, published by the Council of Europe (DECS/EGT (78)30-E), 1979.
8. See Val.D.Rust, 'Norwegian Secondary School Reform', in Comparative Education vol.21, N°2, 1985.
9. The "Third technological/educational phase" is explained and analysed in my Other schools and ours, 5th edition, 1979, pp. 42 and following.
10 See the publications referred to in notes 1 and 4, above.

THE IMPACT OF POST-SCIENTIFIC TECHNOLOGY

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B.R.D.

The paper addresses the prospects of a society which sets great store in technology, yet at the same time turns away from pure science. It explores the common and distinguishing features of (a) science and technology and (b) technology and techniques, so that their respective impacts on society, its members and their self-understanding become more clearly visible. Habitually in our societies, the science-technology complex is perceived as virtually coinciding with culture, contributing cumulatively to human progress.

By separating their contributions, the belief in progress itself comes into focus. By comparing the particular Western self-understanding with ingredients arguably necessary for the completeness and viability of any culture, the double expectations on what progress should deliver emerge.

The two expectations which any culture must seek to satisfy more or less perfectly stem from man's insight that he lacks the by and large unfailing instinct for survival of other species in the animal kingdom. Being rather vulnerable on his own, it becomes a group task, that of his culture, to provide, on the one hand, the techniques for survival (tools, procedures) to make up for his lack of instinct. On the other hand, what we initially shall call a 'good explanation' is needed by this group, that makes it possible to perceive the human lack of adaptation for survival not as a disadvantage. Roughly speaking, these two expectations are met by a set of techniques and by religion, respectively.

Even though religion, a possible source of answers to man's unsecured position in the world as well as, beyond that, to his awareness of his mortality, does not generally have a prominent hold on the science/technology discussion, one can point out the role of both science and technology in both (i) increasing the funds of techniques, and (ii) allaying anxieties about the meaning of life and death. One can also point to a certain kinship and historical indebtedness of scientific rationality to religions of a pronounced monotheistic nature.

From this perspective, the apparent withdrawal in our modern industrial societies ("Western Culture") from a dedicated pursuit of pure science foreshadows demands on technology excessive of its capacity to serve as the single pillar to underpin our culture. (Note that we have left open the question, whether science and technology in conjunction can carry a viable culture). The problem and its challenges, the latter not the least for educators, can be illustrated by "the drug problem", the resurgence of fundamentalisms and creationism, the "counter culture" and its more respectable companion, "the return to Victorian values" and many more modern phenomena.

The search for alternatives and complements to our present culture and way of thinking will not be easy and tranquil. The paper looks in passing at some other cultures (mostly the bullet-holed heritage of "developing" countries). But we should be aware that these are not at all obliged to share their search for answers with us. Nor can we count indefinitely on their willingness to be the testing ground for the soundness of our approach against 'Nature'.

1. Introduction

1. It seems contradictory to talk about post-scientific technology. Technology, we all know, means to apply scientific findings to our needs. According to statistics, there have never been as many scientists in the world as there are today. It seems almost pointless, or at the most an academic exercise, to draw distinctions between them, since their combined efforts appear to be what is needed for progress and our continued well-being.

2. Nevertheless, for some years now we have been witnessing an official concern about the health of the union between science and technology. Economic constraints intrude on the accustomed carefree outlook of our industrialized societies which have become used to expect a better future. The scrutiny of every kind of expenditure leads in particular to queries about the traditional balance between technological and scientific efforts. "Pure" science may still be respectable. What scientists do is no doubt honourable, scientists even command reverence. But why should the public pay for their pastime?

3. Questions like this are certainly being asked and they lead to discussions into many directions at varied levels of sophistication. In this paper, I shall restrict myself to a particular aspect.

4. Our accumulated knowledge, the product of several centuries of scientific and technological efforts, has brought unparalleled improvements in standards of living to the industrialized countries. I feel that I am not alone in suggesting that it may be its very success that has dimmed our perception of the fact that there are human needs which cannot be satisfied by mere survival, however comfortable it may be.

5. One could address this possible shortcoming in the "Modern Project" by a careful analysis of the condition of being human. And I believe that an increasing number of people and groups turn their attention to it, yet such reflections still lack legitimacy in the public domain. Officially, the way to salvation is still seen to lie in technological optimism.

6. No firm solutions are suggested in this paper. I propose rather to offer some thoughts on our accustomed way of thinking. At a time, when science and technology become almost undistinguishable, when science is seen vaguely as a more general form of technology, it seems appropriate to remember what had earlier actually distinguished the two. There must once have been a reason to keep them apart. Before considering to what extent these reasons are still relevant to us today and tomorrow, we shall have to go back to the beginnings of modernity. This ought to be helpful, since we may expect that at the time of their inception the reasoning advanced fitted man quite well with what he perceived as his world.

7. But I suggest that you follow me even one step further, seemingly away from the concrete problems of our present-day world. We cannot pretend that the condition of being human could be adequately summarised in a brief outline. We know that its complexity has occupied the human mind at least since the beginning of history. Nevertheless, some of the present uneasiness about the guidance we can and cannot expect from the conventional wisdom current in industrialised society, seems to be due to us being just human. If it is correct to assume this, then we need to highlight the principal traits of this condition.

8. Thus, let me remark first on man as a creature more vulnerable than any other kind of animal, yet also better equipped to defend himself, since he can create and maintain a culture. The following two sections address the particular culture of the Occident, both at the beginning of modernity and at the present time. Against this background, we can then turn to the implications of a post-scientific era on technology and our lives in general.Finally, we invite some thought on possible compliments

and alternatives to the prevailing Western regard for ourselves and our activities.

2.The background

2.1.Instinct and culture

9. Throughout modernity, and with great determination since the times of Darwin, man has explored the parallels between his condition and that of other species in the animal kingdom. We have found more and more things we have in common with them, but our complete re-integration with the natural world is prevented by a characteristic exclusive to our species. We are not always sure whether it is to our advantage or not: man is guided by instinct, but not very much. Instead he finds himself endowed with an awareness of self, others and the surrounding world. He possesses a reflective capacity that sets him apart from the environment around him. Reflection, too, reveals an additional dimension to his life, and that is time.

10. To live within a time horizon, with past, present and future, could be described as a negative asset. At times we feel even inclined to regard it as that. Being aware of himself, man is condemned to being concerned about himself. He cannot rely on the virtually unfailing and unreflected responses, which instinctively guide bears and beetles through their lives. He has to find substitutes for his faulty instincts to make his survival possible. But that is not the end of his worries. Cats and crickets are not only exempt from caring about tomorrow, they are furthermore blissfully unaware of eventually having to die (at least humans say so and act accordingly towards them). Though many animals may share with us a disposition to experience fear and panic in the face of a deadly threat, they are exempt from our kind of anxiety about our fate in the long run, in the end. To find relief for this anxiety becomes a taxing challenge to man's reflective capacity.

11. Negatively, we might deplore the loss of innocence, or the ability to fit in seamlessly with nature under the direction of instinct. But there is a positive side. We certainly can draw benefits from our human peculiarity. Not being at the immediate beck and call of nature, being capable of perceiving both ourselves and our environment with some detachement, permits us to respond to challenges and opportunities with deliberation. We can reflect about what to do before we do it. Respond to the world

around us we must (we cannot for long withdraw into pure thought), but to consider first what response to choose is our human prerogative. Thus, a first consequence of finding himself, willingly or not, excluded from the spontaneous flow of natural interaction, is man's need and ability to provide for his survival by means of techniques. There is a further aspect to the human condition without which the species could not have hoped to prosper at all.

12. If left to face the world by himself in isolation, man would find it rather difficult to survive on his own wits. One benefit of our reflective capacity lies in that its results can be shared, not only among contemporaries (birds, too, teach their young; and ants lead ants to food anywhere in the house). Rather, in symbolised form - through writing or images - experiences can be stored and accumulated. They can be forgotten and rediscovered even across gaps in space and time. Putting this in the service of survival, a group of people, a society, builds up a fundus of techniques. Men, instead of passing their life in instinctual harmony with nature, have to search continuously for ways and means, procedures and tools, to strike a balance between demands of a more or less benign Nature and their vistas of a living (and dreaming)space that are opening up in the detached scrutiny of their surroundings. The variety and intricacy of systems of techniques developed by one or another part of mankind is astounding. And one can assert without too much hesitation that they are at the least a viable substitute for instinctual guidance -- particularly since with regard to relying or not on instinct man has no option: he can't. Techniques then typically are not the property of one person. They are shared by a group. They are part of that group's culture. In particular, they are that part of the culture, with which the group defends a space in nature against the latter's repeated encroachments. Without a reliable fundus of techniques, a culture and its members perish.

13. We may be tempted to treat as one and the same a group's culture and the set of techniques a group has made its own. This would be a very appealing definition, since it refers to something we can see, for example, in a museum. But, since human beings have to live their lives against a time horizon, they need defences pointing into another direction as well. Thus, even if its technical heritage enables a group to care well for the survival of its members, even if they can push the balance somewhat in the direction of a more confortable life against a nature always threatening to encroach, there still remains a jarring note: man cannot but become aware that all his successes in surviving are futile in the end. He will die. (Even the most confirmed hedonist

will find himself from time to time in low spirits). The advantage of self-awareness, seemingly evident in "relying on techniques" rather than on "guidance by instinct", is again cast into doubt. Man's detachment from nature makes him perceptive to the harrowing insight that he may be insignificant, inconsequential. He can be dispensed with, and exactly that will happen to him when the time is due. Nevertheless, for some reason, man is not defeatist on the whole. He seeks a "good explanation", that can take the sting out of his proneness to anxiety. Such "good explanations" have been found in various ways in virtually every culture. Human ingenuity overcomes the dread and threat of death by bestowing meaning on life and entertaining the notion of an afterlife in which he will again be in full and carefree harmony with the whole of creation, of Being, of the Eternal. "Good explanations" are obviously akin to religion.

14. In our modern world, occasions are rare on which we are exposed to the elements of Nature undiluted; and even less often are we held to reflect about our own mortality. Excursions into the more hasardous, exotic, exciting parts of the world are generally only begun once the return flight is safely booked. And to talk about our mortality other than in terms of a rising life expectancy means to indulge in morbid indelicacy.

15. Yet, in our technologically risk-proofed societies we have not escaped the condition of being human. Like any human being, we need to be able, firstly, to draw up defences against threats to our survival. There is no doubt that we are extremely capable of that. Unfortunately, though, our individualistic culture has made all others part of nature, and thus potential threats to our personal survival. But our cultures pride themselves of being able to cope with any eventuality. Internal and external security are keeping pace with the times. For the second requirement, namely to find defences against the threat of death, our culture is less ready to provide assistance. Answers are still being found, but essentially not in the mainstream of our culture. That I define here, in bold simplification, as the scientific-technological inheritance of the industrial societies. Since membership in a society and culture often coincide, I employ a further simplification by using culture and society at times interchangeably.

16. In summary, the intention of this section has been to argue for a concept of culture which would describe any culture, since it presupposes what all human beings have in common, namely the condition of being human. And by that I mean, that in difference from anything else in nature, man's living and surviving is

ineluctably grounded in his reflective selfawareness taking the place of a rather unreliable instinctual guidance. A culture in its most unspecific description then must be expected to help its members in their search for certainty in two directions, the present-spatial and the future-temporal. The first it facilitates through putting at their disposal techniques in the service of material survival, and the second, through lending legitimacy to the mind's striving to comprehend his fate. A culture supports mutual reassurances that we are capable of staying alive and that life is worth living in the face of inevitable death.

2.2. Origins of the modern project: pre-technological science

17. Modern science began its career as a quest for meaning. Of course, it did not spring from nothing. The search for a kind of knowledge, which vouches for man's understanding of the mysteries of the universe, is old. Especially as a combination of mathematics and astronomy, we find it in Mesopotamia, the Indus valley, in China, Greece, the Islamic world and Central America.

18. But at the beginning of modernity, the cultural fabric of the Western world was shaken by more than the usual amount of change. It is probably a moot point to argue whether the changes in looking upon the heavens, epitomised in the Copernican Revolution, gave men like Columbus the courage to set out on their voyages of discovery, or whether the latter's navigational needs were instrumental in revising our astronomy. In any event, the changes wrought by seeing the heavens in a new light and the appearance of new continents, befell a culture very conscious of its priviliged position within creation, and hence very vulnerable to attacks on its privilege.

19. Not that survival was very much more endangered than at other times. The Western world was heir to a rich fundus of techniques. Guilds, craftsmen, artisans, healers and magicians, peasants and fishermen were proud of them and very reluctant to change their ways, even until today in some instances.

20. It was the self-understanding of Christianity, the place man could claim in the order of things, that was at stake. "The order of things" had been reassuring through a certainty of belief in a creator who not only reserved a privileged position for man in his creation, however inhospitable it might appear at times to his comparative ignorance. But, He also offered protection against the threath of death through the promise of a reward for faithfulness, namely that his soul would live on immersed in the universe's harmony and beauty.

21. The reassurance was broken regarding man's place in this world. "The order of things", rooted in another world, one could nevertheless hope to maintain by discounting the significance of the earthly "vale of tears". This could be seen as a feasible proposition, since man's distinctive trait among creatures and creation was certainly not his body, sharing its materialness with all other things. It was his mind, his ability as "res cogitans" to understand the order and appreciate the harmony of creation, that set him above the rest. Nevertheless, use could be made of the 'res extensae' to prove the affinity of man's spirit to that of his Maker. Science, by dispassionately observing and sifting the ongoings in the material world, was to extract an immaterial, cognitive model of it, that would demonstrate man's capacity to grasp the basic principle by which the Creator assured the world's consistent functioning and continuous changing. For natural Philosophy, the name under which science was known for long, it was of only secondary importance that the minor principles discovered along the way lent themselves to imitation, to technical applications in the material world.

22. The success, or more correctly, the near success of science to reconstruct this conceptual model of the universe, is due in large part to the reduction of the material universe to nothing but evidential material for theory construction. (The concrete details of our world come only today into view again, viz. ecology). But there is at least one other crucial ingredient to the scientific pursuit: its objectivity. Unfortunately, most of the time it is reasonable to assume that not everybody can be completely trusted. One or the other among them may have ulterior motives that tinge what he says or does. Subjective selfishness may be at work, or we ourselves may be led astray by self-delusion. When science set out to search for a confirmation of man's worthiness to preside over nature, objectivity was certainly essential to validate this confirmation. Without Cartesian doubt, man could not hope to arrive at any clear and distinct ideas about his position in the universe. Without it, they would invariably be tainted by subjective-selfish fallability. Objectivity was a virtue. It in no way detracted from the goal of seeking reassurance from understanding the universe. It was centrally employed in the service of this goal.

2.3. Man's earthliness reaffirmed: from science to technology

23. It was virtually inevitable that the accumulation and ordering of knowledge would not remain restricted to contributing exclusively to the self-esteem of the human species. The potential of the

new science to do something with it in and to the material world was seen and praised early on. The 16th and 17th century is also the time of Utopias, whose most remembered writer probably is Francis Bacon. Even today, Utopias, some of them quite a bit less optimistic than their ancestors, are still with us as science fiction. The haphazard, trial-and-error improvements in techniques and hence the human condition could be replaced by a systematic method based on the eventually hoped for complete taming and control of nature's forces. Technology was destined to guide and control the development of techniques, until today, for example, a loaf of bread is neither baked, sold nor eaten without "scientific", i.e. technological, advice.

24. Now, technology has not simply grabbed the results from god-fearing scientists and run to experiment with the world. Over the centuries, science and scientific method continued leading the way towards understanding the world, but the notion of science underwent subtle transformations. Understanding the way in which the forces of nature work, means to understand change. To understand something means to take from its threatening potential. Change becomes familiar. No other culture apparently has prided itself of liking change. it always has been the main source of discomfort to human beings. Yet, now here is a culture considering itself on familiar terms with change. We experience a kind of society which declares change actually desirable and necessary.

25. Originally, Utopias were rather confident and determined about the long-term direction of change, though naturally a bit sketchy on the practical details as these depended on decades and centuries of inventiveness to come. The direction along which change was to be sought was to lead to the goal of a better world for humans to live in. Admittedly, this goal is still professed, on both sides of the Iron Curtain, though primarily only in Sunday speeches and other morale-boosting exercises.

26. However, at least not later than the last century the notion of goal, of there being a specific direction into the future, came into disrepute. Theleological thinking could now be explained as being an illusion. Nevertheless, change continued to be observed; technological ingenuity made man an ever more capable expert at changing this aspect or that part of the world around him. Change in a profusion of manifestations became the most visible expression of technology.

27. Today, the subtle transformations in the perceptions of science have added up to a redirection of outlook. Scientific

research is by and large no longer required to profess a commitment to reassure, to underpin human existence. There is no obligation now for the scientist to strive for a demonstration that man is in tune with creation or even a Creator. Yet, objectivity is still useful for unravelling the functioning of natural processes, for making such processes reproducible at will, and for employing them in controlling and reshaping nature. At the same time, even though no theleological reasoning can be invoked, one can still see a direction in the scientific undertaking: it grows, we know more and more things. We can discern progress.

28. Fortunately, an explanation has become available for this state of affairs: Evolution. I say "fortunately" for two reasons. First, it is very disheartening for human beings not to find an explanation. And: it so happens that this particular explanation still assigns to the human species the prerogative of leadership.

29. By merging the concept of evolution with that of science, the scientist's role and in particular his objectivity appear in a different light. He need no longer employ his objectivity for the sake of some ultimate goal. Objectivity is reduced to neutrality. (Maliciously expressed, "objectivity" might be called "species-peculiar selfishness".) and the scientist need not be preoccupied with the direction of the scientific enterprise. It can be attributed to the evolutionary process. Progress becomes akin to a Law of Nature. The versatility of this enlarged concept of science, the sweeping exemption of man from having to shoulder responsibility, may explain the preference given to the term scientist over technologist or technician. The latter two may fear being blamed for the tangible outcomes of the activities their professional label commits them to.

30. In fact, however, science now hardly becomes visible in any other way than through technical manifestations. Progress is no longer to be evaluated in the distance that still separates us fromt the goal of being privy to the Creator's design. Progress is now measured as the distance already travelled along the path of technological change. Any technological achievement is nothing in itself, it is only a milestone that recedes, covered in the dust that we kick up as we rush ahead, as long as there are no cluttered horizons forcing us to grope for the brakes.

31. However, there are now some people, who say that the earth is only a small planet. There are others, who are not very optimistic about economic growth, about the physical resources that we can continue to feed into the process of technological change. There are many from whom talk about progress promises

nothing, if not increasing famine, misery and hopelessness. And there are a few who ponder the responsibility of scientists, technologists and all of us for this planet and each other.

3. The prospect: post-scientific technology

3.1. Science defeated?

32. Post-scientific technology: the term should no longer seem at all contradictory. We have talked about a change in what the word "science" means. Knowledge per se is no longer much valued. Instead, an ever increasing amount of knowledge of how to do things keeps our society busy doing them to such a degree, that little time is left to sit back and contemplate what best to do or whether to do it at all. Science loses a justification of its own and merges with technological "R&D" (Research and Development).

33. It would then seem easiest just to let the argument rest there and accept that science and technology are very much the same.

34. However, I suggest, that there is cause to remain attentive not so much to a scientific distinction, but rather to what is imposed on us by our condition of being human, or being mortal and at the same time capable of reflection and self-awareness. There is no guarantee that high (not to speak of rising) living standards can divert us forever from nagging doubts about the meaning of our existence.

35. If we keep this in mind, then the ongoing effort of a relatively small number of scientists can still be seem to respond to an essential human exigency, though it does not promise any immediate technological breakthroughs. Mention may be made here of astronomy, high energy physics or even the use of space probes and radio astronomy to seek contact with alien forms of intelligence. Yet even these small hands of "pure" scientists, e.g. a large part of those at the European Centre of Nuclear Research (CERN in Geneva), feel prompted to justify their activities by the technological, marketable spin-offs generated through their research needs. Admittedly, the expenditure involved in much of pure science today is incomparably much higher than in the times of Newton or Niels Bohr. But that is also the case with the equipment employed for dealing a good blow to the enemy. We may soon reach the point when even we in the industrialised countries can no longer afford both or either. While we are still in pursuit of science at least some attest to a concern for humaneness, of

which virility surely can be but one aspect, and that quite often a destructive and demeaning one.

36. Thus, for the time being, we have not yet entered the post-scientific era proper. TV-programmes presenting theories about the first new seconds of the universe or the ultimate constituents of its material base have some entertainment value as is fitting for them in the market of mass communications technology. But their presentation rarely avoids achieving something more. These programmes rekindle a sense of awe, reminding us alternatively of our insignificance and the astounding feat that man can build up a sensible whole from the most disparate and tenuous pieces of evidence. Science, however imperfectly it may be understood by the outsider, still serves quietly in the background. It intimates to us that there may still be reason to dream and to believe in the existence of larger vistas. There may be more to being human than resigning oneself to the demands for adapting to a forward-rushing technology. There may be insufficient justification for homo-sapiens to treat the world (and, incidentally, any non-Western society, non-industrialised culture) as his executive and inexhaustible testing material.

3.2. The post-scientific scenario

37. Let us then take a small step ahead of our times. The only change I introduce is the disappearance of research whose only justification is human curiosity, a yearning for the "larger picture". This will not have happened out of spite, but simply for lack of funds. Those who wish to become scientists, must do so with the clear understanding that theirs is the role of pathfinder scouting for new, marketable technologies.

38. What can a young person expect to find when growing up in a post-scientific technological culture? He or she sees a society bustling with activity. The concentration of efforts on prying out from the material world ever new tricks, which may lead to new useful - which is held to be synonymous with marketable - products, is paying off. There is a continuous stream of novelties, a few of them useful even in the further sense, namely being useful for repairing some of the inconvenience or damage caused by a previous novelty. However, the young person will have to strive hard, preferably forgetting whatever anybody whispered to him about fairness, to get a piece of the action. Quite logically in tune with the development of a technological outlook, people are pieces of human resources; which may be brought into the production process only when this type of raw

material is required. They are not entitled to any preferential treatment deriving simply from their being human rather than, let's say, hydropower.

39. But our young person has overcome these hurdles, and, perhaps like a majority of his contemporaries, has now the means to frequent the market place. For a while, he or she may marvel at all the things to buy, though there is a chance that the ability to wonder has drowned already in childhood in a flood of toys. The person may, however, do his duty by the Gross National Product and replace the fourth-generation computer with the fifth generation. But after that, what? Those of you meeting youngsters in the classroom or university can probably paint the scene in more vivid colours.

40. Before returning to the real world, allow me to outline just a couple of characteristics of technology-only societies. Or, cultures? These are the need for growth, even accelerated growth, and the disease of secrecy.

41. When science is no longer on the way towards something beyond it, but rather is simply on its way, the only utilisation we can make of what we know about the workings of nature, is to try them out on her. Technology can contribute to the improvement and creation of techniques in the service of survival. But there comes a point when all conceivable needs of keeping alive materially can be met with the knowledge already available. That would seem a time slow down, while of course, keeping an eye on the quality of the defences protecting our livelihood. However, human imagination and curiosity, inseparably linked with man's reflective capacity, needs an outlet. That can now be only more techniques, more experimenting with the material surroundings. Without a pressing need though to keep something, interest in it fades. It needs replacement by something new. The first need for change becomes proportional to what thus needs replacing. Exponential growth becomes an existential need. A virtually inexhaustible supply of scarcity has been created. And with it, our modern economy can thrive on the nefarious stimulus of competitors trying to monopolise the customer's fancy.

42. When the pursuit of science is no longer valued for the light it sheds on the human condition, when it is no longer entrusted with a responsibility for mankind as a whole, its only legitimate manifestation is its tangible results. Products, however, can be owned. And men go to great lengths to establish ownership. Technology becomes the jealously guarded property of the smallest possible production unit, sometimes the size of a nation, rarely

larger. Instead of science which was conceived to unite, we are left with technology as a divisive force. Secrecy becomes a pervasive concern. Free flow of information may be restrained, e.g. by governments vetting papers to be delivered at scientific-technological conferences. And relaxation of secrecy by its owner may have to be bought at a very high price. One might imagine, for example, that notwithstanding a number of substantial reservations, European governments would be prepared to participate in Star Wars research, so that they will not be cut off from information about a wide range of technologies deemed necessary for facilitating further growth of their national industries.

3.3. The impact of post-scientific technology

43. Back in the real world though, things are guided not only by technological imperatives. Our culture is still rich and varied. Those willing to search among its resources can still find answers to questions about themselves, which differ from referring them back to the living standard they have managed to achieve. I believe this to be the case, even when a government can declare that, as long as competing countries produce more qualified scientists, engineers, technologists and technicians, then the result is likely to be "a further fall in our relative standard of living and our ability to sustain our cultural heritage" (quoted in "The Guardian Weekly" of 2nd June 1985).

44. However, we do not make a great show of the breadth and width of our cultural endowment. Syllabi, for example, are being re-evaluated and streamlined to better prepare the next generation for the battle of technologies. Anyway, there is no point in trying to disinvent technology. It would be senseless to advocate going back. Human beings, not as national subjects, not as objects in the evolutionary process called survival of the fittest, but as persons having at best about four-score years to live, prefer, if possible, to see their lives ahead of them. They will search among what comes to their notice, be it old or new - though there is "nothing new under the sun". And, they may well find themselves in isolation.

45. This isolation may be singled out as the essence of the negative impact of the post-scientific technology. (Technology has beyond any doubt positive impacts, but there is no need to discuss them here, since they are daily being praised.) In its negative impact, isolation may be thought to be outranked by the threat of us exhausting our small planet. Consider, however, how

isolation, anxiety, fear, panic lead to hitting blindly at what deserves to be preserved.

46. We have stayed away here from entering into ethics and moral considerations. We have though spoken for the recognition of the need to belong as essential, to live under the human condition. There is, furthermore, a consequence very close at hand: violence is a language that has given up hope of an answer. And in our world, the potential for violence is obvious. Whether we can prevent it from becoming increasingly part of our reality, remains to be seen. For the time being, people, particularly young people, are mostly left to their own devices and initiative in their search for sense around them, and they use them. They experiment.

47. Taking drugs may appear to promise more acceptable vistas to the taker. Yet, it leads away from the world we have to live in, and from the others we need to live with. Many drugs even destroy life outright. But supporting a flourishing drug trade by criminalising the process, would not seem to be the answer. It only adds to the lure. As long as human beings feel forced to search for an escape, they will find ways. If it is not drugs, there is still suicide and there are suicide missions. Despair and the experience of rejection cannot for long be fought by the riot police.

48. There are other routes to search for meaning, less extreme in the isolation and failure they lead the individual into. Although they are the ones often given the label of "extreme". In a sweeping generalisation, which by no means claims to do justice to every particular instance, I refer her to sects, fundamentalisms, extreme parties. Their strong point in attracting followers seems often not to be the substance of what they proclaim to be, their truth, but rather the distance of their knowledge from that of normal, unfulfilled people. The comfort for those who belong, lies in the specialness promised to them. Therefore above all, distance must be kept, fanaticism becomes a righteous weapon. The result is again isolation, this time of relatively small groups, which, though, are ready to use their numbers to divide society further more. Here too, there is little hope that the lasting remedy may lie in suppression and the use of force. (If we were to look at it from a global perspective, we possibly might have to include into this category the resurgence of nationalisms - and the dismantling of the United Nations.)

49. As an encompassing remedy, some quarters recommend the return to "Victorian Values". It has the virtue of acknowledging

that something is required to hold us all together. But it does not seem to be the best prescription to overcome the discontent with our culture, even before knowing in detail which Victorian Values are supposed to be resuscitated. What can be recalled, nevertheless, is that they are a set of values that promoted the technological culture which is found wanting now. And also, a small though relevant point, it seems to make it a virtue to snigger at those with a lower living standard, as long as you give, from time to time, a dime or penny to charity. Thus, in effect, the return would again end in isolation.

4. Conclusion: the search for complements

50. The foregoing remarks were intended to show that societies restricting themselves to the sole pursuit of post-scientific technology may find it increasingly difficult to be accepted as a culture and home by their members. Even though a society may excel at offering techniques in an embarrassing profusion, it is in danger of deserting its members when it offers less and less assistance in tending and caring for a common ground on which mutual assurance can grow. Without confidence in the meaningfulness of the peculiar human condition, of being alive albeit mortal, society disintegrates. The search for meaning, and still more so the ideas that it might be a common need experienced by everybody, is instead being adorned with the aura of the ridiculous, distracting as it were individuals from joining in the serious business. Yet, people risk their lives and sanity for the sake of a hoped for answer.

51. If one could detect some levity in talking about isolation just now, I admit to it with a sad smile. Sad, because it reflects doubts and uncertainty about where and how a solution can be nurtured. The prospect of a society of isolated individuals averse to finding sufficiency in technological splendour, yet definitely no longer fit for the simple life, is similar to what we imagine, when we talk about the future "after the bomb". Taking recourse, in the meantime, to Church (and some may want to add the Army) as character and personality building institutions may mitigate the symptoms. But we also need to come to grips with our exaggerated sense of security, fanned by technological progress, which makes it a bad joke to suggest that there be still disquieting questions about ourselves, to which we have not found the answers. One beginning might be moderation. We might profit from easing the nervous concentration imposed on us by having to prove relentlessly that nature and those less clever than us are at our mercy.

52. There is a still inconspicuous challenge emerging in the midst of technological progress. I refer to the debates about "Limits to Growth" sponsored by the club of Rome some years back. I am in no position and see no necessity to argue about the correctness of their quantitative predictions or the time horizons calculated for the exhaustion of this energy source or that raw material. Quite irrespective of the accuracy of the facts involved, the very discussion has given notice to us, that we are not almighty and invulnerable, that we cannot forever make technological growth the focus of our hopes. Admittedly, this too is only a challenge and not the outline of an answer.

53. We might then consider looking further afield. Our culture, or what is left of it, is not the only one in the world. The challenge of living and surviving together has found many answers. Eastern cultures, offered as remedies in institutes on the North American West Coast or enticing hitchhikers to roam across India, are famous examples. Less notorious for their attraction are the ways in which farming communities in Africa and elsewhere balance their needs in tune with the seasons, providing for the technical necessities of survival in the wet season and reserving the dry season for activities renewing their covenant with nature and divinities.

54. We ought not, however, to expect instant benefits from these inspections. Cultures are not so many store rooms, holding conveniently packaged take-away products. Cultures make sense to their members only in their experiences balance, a balance that does not exclude unpalatable harshness. Though, man can communicate and learn. Immersing oneself in a culture not one's own, may lead to insights about new connections and possible growth points in the only culture one can really hope to find a home in, namely one's own.

55. There is a further caveat. Many of the cultures we dream of as "how we should do it, too", have been able to serve their communities well in times quieter than ours. Coming into contact with the pervasive emissaries of civilising change has meant exposure to new turbulent forces competing and outdoing in efficiency those of nature. But it has also introduced whatever attractive sides there are to technology, such as the promise of comforts and less hardship. Technology cannot be disinvented or withheld. The balance to be found in any new culture needs to take this into account. (Anyway, none of the cultures having endured our influence are obliged or overly willing to share their secret consolations with us. We cannot promise development and aid, make people abandon their ways as inferior and lacking in

intelligence, and then expect to take away with us what little is left. But this would be another paper.)

56. To end, let me try to answer to a question put at the beginning: why should the tax payer pay for the pastime of the scientists? Given that human beings stubbornly continue to ask about their paradoxical presence on earth, and given that science is the attempt still most plausible to us in its endeavours to acknowledge an explicit obligation to mankind, we ought not to deprive ourselves of it. Whatever it costs, it is still much cheaper than a Falklands war, which brought elation for a short while to part of 1% of the earth's population. We should also not hold it against scientists, that they seem to enjoy what they are doing. We still might find ways, even cheaper ones than those being promoted in our civilisation, for all of us to find joy in our decades of being alive.

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FIVE MODELS FOR USING COMPUTERS IN SCHOOLS: PERSPECTIVES FROM THE UNITED STATES OF AMERICA

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Many of us who have served as teachers/consultants/advocates for introducing computers into schools are saddened and frustrated by what appears to be a tremendous confusion, even conflict, surrounding this process. This is due partly to the fact that computers represent change and change is always difficult. However, we began to see another and equally fundamental problem which is accompanying the computer revolution. This problem has three critical factors. First, people subscribe to strikingly different models for utilising computers in schools (2). Second, this is often true even for collections of individuals working in or for the same institution: e.g. teachers, principals, parents, students, school board members,etc. Third, these models are largely implicit; that is, people are unaware of the major assumptions which they hold about how to use computers in schools (3). As a result of these factors, protagonists argue themselves blue in the face about what's the best computer to buy, for example, when what they should be arguing about (or: better, discussing) is which model of computer use is appropriate for a given educational setting. Once agreement has been reached on the model which deserves implementation, issues relating to the nature of hardware; software; in-service training; client population; and so on are mostly self-evident, i.e. no more arguments!

In our analysis we have identified five models which have been espoused by some segment of the population of "experts". The most exciting model is the computer as intelligent tutor, an idea espoused by Patrick Suppes, among others (4). Unfortunately, this model is a long way from practical realisation (5), or as Michael Crichton so aptly expressed it in Electronic Life, rather than looking to artificial intelligence to solve educational problems, "You'd be better off whispering sweet nothings into the tailpipe of a Chevrolet."(6). In more prosaic terms, it will be several years before really intelligent computers are cheap enough to be used to teach all students the Pythagorean theorem, or the declension of a Latin noun, or even how to tell time.

Unfortunately, many educators got sold on the tutor model at some point and these are the people who continually gripe about the dearth of good educational (read"tutorial") software.

The vocational model currently dominates public school computer classrooms (7).There are several reasons for this, not the least of which is that school purse-strings are held by school-board members and PTA presidents, who, more often than not, are business people. The design of a vocational program is relatively straight-forward because schools need only get in line and stay in step with the business community: as new vocational applications are developed and applied, they can be transferred directly to the computer classroom. There is widespread public and political support for the vocational model as reflected, for example, in the rush to develop mandatory curricula in computer literacy (8). Some of the more typical elements in a vocational model include (9): minicomputers; dedicated word processors; Apple and IBM personal and micro-computers; and this equipment is used for: word-processing; typing; drafting; programming; and computing. The vocational model is most often utilized in a labsetting by a special teacher. While there have been some very positive additions to the curriculum as the result of the push to implement the vocational model, we believe it has been vastly oversold and is responsible for the increasingly evident backlash against computers in education (10). Learning a programming language and/or learning computerese(the typical content of computer literacy classes) are not necessary prerequisites to learning to use computers (11). To succeed in the computer age people need, above all else, to "make friends with the machine" (12) and the typical computer literacy course is far more likely to lead students to "make enemies with the machine". Implementing the vocational model can be very expensive (13). Business demands the latest, most powerful, and versatile hardware and software available which inevitably translates into "most expensive". For schools this means that they will be able to install at least five "computers"for every one "electronic workstation". In addition to the very high hardware and software costs, the vocational model typically requires a "dedicated" room and instructor, as we have seen. Thus, schools which wholeheartedly embrace the vocational model are often faced with three unattractive choices: to rob other areas of the curriculum materials and/or capital budget to pay for the computer program; to run an "affordable" program in which the equipment and materials are obsolete or otherwise unlike that found in the work place or: offer a high quality program to a very select group of students. The resolution of this dilemma lies in implementing the vocational model only where it will do the greatest good.

It makes sense, for example, to teach keyboarding, word-processing, and spread-sheets in conjunction with an 11th-12th grade business/secretarial track, as all of the corrolary skills can be integrated at this time and the newly acquired computer literacy can be applied directly on the job following graduation. It makes sense to teach programming as part of an advanced placement 12th grade math/science track.The programming skills will directly benefit the students in their science and math classes and will aid them in their college classes in these subjects as well as in engineering. Contrariwise, it does not make much sense to try and implement the vocational model in the second grade.

The most venerable of the five models is the computer as instructional medium better known as computer-assisted-instruction (CAI). As long ago as 1972 (dark ages in computer history) fully-fledged curricula in spelling, grammar, math, geography and so on were available on such main-frame based packages as PLATO, for example (14). The cost of implementation was, of course, prohibitive, but, over the years, CAI has become cheaper and better. Caveat emptor the A in CAI still stands for "assisted", don't expect computers to teach a child anything much or even remediate (in the sense of diagnosis/remediation). However, if you are concerned about getting children to practice skills or rehearse facts often enough to achieve real mastery, CAI is for you (15).Inexpensive CAI comes along just in time to save students and teachers from being overwhelmed by the latest wave of "back to basics" hysteria. Students and teachers avoid drill and practice exercices not because they'd rather be clarifying their values but because D+P worksheets are boring to do and even more boring to grade. D+P computer games, on the other hand, are less boring (in fact, they are most appealing to the kids who need the most practice) and the program corrects the students' answers (16).

Enhanced student motivation and reduced busy work for teachers are the two principal benefits available with the best instructional software (and make no mistake, there is a lot of excellent software available for this purpose). In other respects, those who advocate and use the "instructional medium" model have not ventured far from the content and methods found in other, more traditional, instructional media.

Once a decision has been made to implement the CAI model, one's choices are quite varied. We would recommend either Commodore 64 or Apple II systems, the latter has somewhat more CAI software available, but the hardware costs at least twice as much per station. Each system must include a CPU, disk drive, color monitor, and a pair of joy sticks. With respect to software, one can either purchase a package deal from such companies as DLM, Milliken, MECC (this is not an endorsement) whereby all of the fundamental skills associated with the elementary grades have been included and are carefully sequenced and "levelled" or, one can, with careful and painful evaluation, create a D+P library from among 100's of programs available through dozens of publishers. Most programs do not require teachers be particularly "computer literate" so this model can be implemented easily in individual classrooms. It can also be implemented in a dedicated computer classroom with equally good results. At present the principal use of CAI in the middle and high school would be for the review of skills taught in K-6, however, good CAI programs in typing, algebra, and anatomy are available and programs in physics, chemistry and geometry will soon be available.

Note that the CAI model implies a commitment to curricula which were present in the classroom before the computer arrived (17). However, our last two models offer interesting possibilities that have only rarely been explored in the schools.

The fourth model is hard to describe but it is one which we think may be very appealing to some teachers. This is the computer as mental gymnasium. Exponents of this model include such people as Seymour Papert and Herbert Kohl. The LOGO programming language, for example, was developed to enable children to interact with the computer and, thereby, acquire the mental discipline of a programmer (18). Patricia Greenfield in her recent book Mind and Media ascribes somewhat similar qualities to wordprocessing (19). By extension we might expect electronic music, art and design to stimulate the development of thinking, planning, communicating, imaging and other "high-order" skills. Furthermore, one can argue very convincingly that these skills will be heavily utilized by individuals who will lead the high-tech revolution.

The major difficulty with implementing the mental gym model is that it really does require a leader/organizer who knows what he/she is doing (20) - this is the model which can't be copied out of a manual, or copied from business or picked up in a university course, it must be built from the ground up. One has a wide array of choices again, but it is important to point out that one can put together (e.g. find software to support) a fine mental gym based on the cheapest "real" computer on the market, the Atari 800 XL; also, a full array of well-designed and inexpensive peripherials are available for this machine.

A second difficulty with the "mental gym" model stems from the undeclared goals of mental gymnastics. Many schools have allowed LOGO, for example, to be wholly incorporated into their vocational model. Thus students are given "exercises" to carry out in order to "master" the "subject". This, of course, totally defeats the intentions of the people who developed these child-sized programs. Instead of the computer becoming the object and the child the programmer, the child is the object and the teacher is the programmer -- in other words, business as usual. On the other hand, most children do not do well in a purposeless environment. Students engaged in programming, word-processing, graphic design etc. without having to fulfill an "assignment" often flounder around rather aimlessly (the exception: academically-gifted children, and they may be the best clients for the mental gym model) (21). Thus we would recommend that educators who are interested in implementing the mental gym look carefully at various "construction" programs. These require the mental skills associated with mastering the computer environment, but they come with built-in, kid-oriented goals (22). Outstanding examples of the genre include: "The Pinball Construction Set", "Robot Odyssey"; "Bank Street Storybook"; "Adventure Master" and "Ranch". A final word of caution concerning the "mental gym" - a ten minute a day "workout" does very little good. To get full benefit from their work-out, children need to spend at least a half hour and preferably an hour-at-a-time on the computer and, once they get started on a project, they should be able to work on it every day or else they will lose interest.

Our final model, the computer as activity corner, is rarely seen in schools although it is our personal favorite. It is far and away the easiest and cheapest to implement. Two concepts link this model to the activity corner (23). First, if you have a decent software collection, there are all sorts of things you can do with a computer. Second, learning to do these things occurs largely without instruction or other intervention on the part of the teacher. Thus a teacher can: get his students fully involved with computers; acquire a superb reward for good behavior and good work; provide outstanding enrichment opportunities and so on, without knowing anything about computers, computer-based-education; programming or what have you (24). Atari 800XL or Commodore 64 machines are appropriate. There are more programs on the market for the latter, but a station costs at least one third more and disk programs are not self-booting. The disadvantage of disks which have to be booted is that kids don't read the documentation or it's been lost so they come to the teacher for help. However, both the Atari and Commodore machines have ROM cartridge ports and cartridges do self-boot so we recommend that pre-school - first grade activity corners only use programs that are stored on cartridges.

Of the three major markets for commercial software: business/industry; home; and school, this last is by far the least lucrative. Hence, educational software as a category is relatively uninspiring (25). The activity corner concept encourages a teacher to look at the "home" category where the pickings are much richer. There are many, many games and other "fun" programs that offer valuable opportunities for both intellectual and social growth. Among the leading publishers of software which meet these criteria are: CBS; Spinnaker (including their various subsidiaries like Fisher-Price); Sierra (especially the Disney line); Electronic Arts; The Learning Company; Mindscape; Sunburst; Broderbund and Xerox. The best source of ideas and, indeed, for the loan of programs, are the kids themselves, particularly those who have access to a computer at home. Just as there are children who live and breathe baseball or rock star trivia, there will always be a few around whose knowledge of computer software is near encyclopedic. Computer activity corners can also be valuable additions to the middle and high school classroom. Here we would emphasize the various simulation and adventure games (26).

We intend in the future to expand this paper and draw on the accumulating research literature to articulate these models in greater detail. However, we would like to end with a word of advice. That is, that educational personnel need to spend a great deal of time discussing the merits/demerits of particular models for computer use in schools. They need to be clear which models are relevant and what the components of those models are. Then they need to decide which model(s) to implement where and in what order. What we keep seeing are good models in bad places (e.g.vocational model in the second grade) or mixed-up models (CAI/Mental Gym) that don't do anything very well. Next comes a careful look at the budget. Only when these issues get resolved can the discussion turn to the actual purchasing decisions. However, if a lack of consensus or lack of money at the district level has kept computers out of your school, go for the activity corner model - the PTA will love it.

Notes

1. Our work has been consistently supported by the Edith Bowen Laboratory School, as well as by: Atari, Commodore,

Sunburst, Spinnaker, Electronic Arts, Microlearn, Sierra, Disney, Xerox and many other companies too numerous to mention.

2. A.C. Wilkinson and J. Patterson, Issues at the interface of theory and practice in A.C. Wilkinson (ed) Classroom Computers and Cognitive Science, NY: Academic Press, 1983.

3. J.M. Bobbett, Subjective Meaning of Computer, unpublished Ph.D. dissertation, Arizona State University, 1984.

4. P. Suppes, Computer Based Mathematics Instruction in R.P. Taylor (ed) The Computer in the School: Tutor, Tool, Tutee, NY: Teachers College Press, 1980.

5. The most advanced prototypes are the BUGGY and DEBUGGY programs to diagnose a child's "buggy" algorythms for solving arithmetic problems, J.S.Brown and R.R.Burton, Diagnostic models for Procedural Bugs in Basic Mathematical Skills; *Cognitive, Science*, 1978, 2, 71-109.

6. M. Crichton, Electronic Life: How to think about computers, NY: Ballantine, 1983, p.43.

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TECHNOLOGICAL INNOVATION IN POSTSECONDARY EDUCATION AND ITS IMPACT ON COMMUNITY LEARNING CONCERNING PERENNIAL AND CURRENT ISSUES OF PEACE AND WAR

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The United States is a rare experiment of, by, and for the people. When, in the past, the right to life has been threatened, the American people have risen to action. The issues of nuclearism call Americans to participate in today"s decisionmaking as "We the People". Peace is a people"s issue. The pursuit of happiness is based on peace--not war. A people"s policy must be one of living--not steering down desolation row.

The French existentialist, Albert Camus, believed that every generation sees itself as charged with remaking the world, but that his, he felt, knew that it would not remake the world. Its task was greater: to keep the world from destroying itself. What role can the universities play in the process of restructuring human minds so that the threat of nuclear holocaust might disappear. The universities are not only logical places to implement a new society, but they are the practical foci--especially the colleges of teacher education. Yet there is strong evidence that suggests that the university has become a hindrance to this worthy goal. There is an apparent contradiction between two philosophers as to what should or could be, and what is. Whitehead believed that "The justification for a university is that it preserves the connection between knowledge and the zest of life, by uniting the young and the old in the imaginative consideration of learning... Imagination is not to be divorced from the facts: it is a way of illuminating the facts" (1). The contemporary Canadian philosopher, Ian Hacking, has pointed out, on the other hand, that the universities play a vital role in weapons production in American society (2). Many university personnel produce vital weapons" research and new personnel. I believe, however, that the time is long overdue for university dialogue to initiate the university toward the key role of achieving peaceful aims in a world of rapid communications and transactions.

The Wichita State University Peace and War Projects were examples of pluralistic and pragmatic educational philosophy. All the projects have been interdisciplinary and interactive, including major contributions from teacher education and its youth orientation. Though our foundations of education unit introduced peace and war issues, we have certainly not arrived at what Douglas Sloan believes--that peace and war issues must become the crux of all education (3).

Dick Ringler has suggested that in educational practice there must be two aims in order to deter nuclearism:

1) Individual educators must commit themselves to longterm efforts, retraining themselves as necessary and redefining their career and research goals in the interest of the general welfare; and
2) They must make a strenuous attempt to institutionalize these efforts (4).

But at the same time, educators must guard against what Richard Lyman has stated: "Almost the worst thing the universities could do would be to opt for a few easy and dramatic gestures, satisfying outlets for our frustrations that might make us all feel a nice warm glow of selfrighteousness, but would do nothing to advance our basic understanding of the problem" (5).

With this last idea in mind I will try to be cautiously optimistic in the description of the postsecondary technological innovations that Wichita State University has implemented and the consequential impacts on the community. In general, the peace and war projects concerned (a) technology"s impact on society and education, and (b) the utilization of electronic documentation to make an impact on society and and education in this region and throughout the nation. The actual projects included:

1) faculty lecture series, utilizing an interdisciplinary approach to peace and war with three faculty members each time and an emeritus moderator:
2) conference, "Central America Today", featuring Mariano Fiallos, the President of the Nicaraguan National Supreme Electoral Council and recent President of the National Autonomous University of Nicaragua;
3) conference, "Wichita Conference on Peace and War Issues in a Nuclear Age", featuring Richard Garwin, Robert J. Lifton, Douglas Sloan, Earl Ravenal, members of the World Policy Institute and the Cambridge Forum, the First Lady of Kansas, members of the International Association of Machinists and Aerospace Workers, Joel Yudkin, Joseph Weizenbaum, and a wide variety of local scholars;
4) media creation and utilization for the purpose of reaching out to the community at large to informal educational settings (home, car, taverns, etc.) by use of campus radio and television;

5) national and international networking for wider impact and media distribution; and
6) innovating new, interdisciplinary curriculum for various perspectives on peace and war.

The humanities provided the basis and means for allowing scholars and the general public opportunities to critically discuss the perennial and current issues of peace and war. Humanities scholars and scientists teamed up to insure the interdisciplinary nature of the projects. Each session was then structured as a colloquium so that ideas, values, and purposes from a variety of human experiences could help imaginative minds to inquire about new possibilities. The humanities provided a non-manipulative search for the truth. They also recognize values as being central to human understanding.

Historical perspectives helped to put the current dilemmas in relationship to one another. Inquiries such as "Who are we that we might use technology to bring a destructive end to all of humanity?" and "What actions migth really make a difference?" arose in critical view. The critical analyses searched for answers, but often led to more questions.

Technology provides the means to innovate many social comforts. It also may be understood in both material and non-material frameworks. It may be organizational as well as physical; it may even influence ideas and beliefs. Technology is tools to protect that which is valued from the past and to shape a future. "High" technology is considered sets of tools that may rapidly alter the past or accelerate humankind in communicative relationships in time and space. How, for example, is electronic information documentation and communication changing our lives from the past? Can all this "high" technology bring us to a more liberating educational experience? Or do they fall into the hands of vested interests and only serve to imprison the minds of many human beings?

The first innovations came from the minds of many participants: that is, ideas and values had already been rolling around in the grey. But in the minds of a few peace and war had already become the highest priority. Professor of Anthropology Dorothy (Dotty) K. Billings called the first formal group session to order early in the Fall 1984 semester. Therefore, the first key component of change was to form a committee of interested faculty and staff.

In addition to organizational innovation as we grew and developed, it soon became obvious that one of the most far-reaching public colloquia would even be better if electronic documentation was utilized for the purposes of further broadcast and classroom use at later times. Therefore, the interrelationships among nos. 4, 5, and 6 as means and broader aims of the themes presented in either 1, 2, or 3 became vital. Media creation of events 1, 2, or 3 could be used in formal or informal educational situations. The events could be played back during the new course in Peace and War Studies or could be broadcast locally or nationally for wider impact.

Before the first event a great deal of time and energy was expended upon promotion (faculty, students, newspaper, newsletters, radio and television). Student and university coverage was vital. The first event in the faculty lecture series was held Sunday night Feb 24, 1985, featuring:
War and Peace: An Overview
Moderator: Dr. John Breazeale, V-President of Academic Affairs
1st Speaker: Dr. Warren B. Armstrong, President and Professor of History, Wichita State University, "There shall be wars and rumors of wars..."
2nd Speaker: Louis Goldman, Asst. Prof. of foundations of education, "Peace Education:Issues and Perspectives"
3rd Speaker: Dr. Jacqueline J. Snyder, Assoc. V-President of Academic Affairs and Asst. Prof. of American Studies, "War: Whose Interest Does it Serve?"(6)

The use of administrative personnel in planning and implementation was one of the reasons for success. Another aspect that seemed to have worked well was the use of emeritus professors as moderators. The faculty lectures series was also accompanied by university radio broadcasts of a national colloquium, the Cambridge Forum Series and interviews with our own faculty the week preceding any of our major events.

The next three sessions of the faculty lecture series (every Sunday night) had these respective themes: War & Peace: An Historical Perspective, Religious & Ethical Perspectives on War & Peace, and War, Peace & Global Resources. We had reached the halfway point and it was Central American Week. Therefore, on Saturday March 23, 1985 we held open and free to the public the conference, "Central America Today", featuring:
Moderator: Dr. James W. McKenney, Chair and Assoc. Prof. of Political Science
1st Speaker: Dr. Pedro Bravo-Elizondo, Asst Prof of Spanish Literature
2nd Speaker: Dr. Charles Stansifer, Director of the Center for

Latin American Studies & Assoc. Prof. of History, "The Kissinger Commission: One Year Later"
3rd Speaker: Mariano Fiallos, President of the Nicaraguan Supreme Electoral Council and President of the National Autonomous University of Nicaragua, Visiting Prof. of Political Science, The University of Kansas, "Twentieth Century U.S.Nicaraguan Relations: A Nicaraguan Perspective"
4th Speaker: Jim Johnston, member of ACLU and on recent mission to Central America with a higher education group, "Human Rights in El Salvador"
5th Speaker: Donnie A. Lawrence, Director of Peace and War Studies and Asst. Prof. of Comparative & International Education, Wichita State University, "The Rise of Militarism in Central America"
This conference drew nearly one hundred sixty people in the audience and sparked a great deal of lively debate and interchange.

The final four events in the faculty lecture series had the following themes: Peace with Technology, Peace & War in Literature and Art, Cultural Values and Socialization for Peace & War, and Education, Culture, and Politics: Distinguishing Between Difference and Conflict. The final session was critical because it not only finished the faculty lecture series, but the Wichita Conference on Peace and War started five days later. Therefore, the final faculty lecture series event had to serve as a transition and linking pin. The final session featured:
Education, Culture, and Politics: Distinguishing Between Difference & Conflict
Moderator: Dr. Phyllis Burgess, Professor Emeritus of Education
1st Speaker: Dr. James W. McKenney, Chair and Assoc. Prof. of Political Science, "Teaching About International Conflict"
2nd Speaker: Sally L. Kitch, Asst. Prof. of Women"s Studies, "Does War Have A Gender?"
3rd Speaker: Dr. Donnie A. Lawrence, Project Director--KCH Peace & War Studies and Asst. Prof. of Comparative/International Education, "Multicultural Education for Global Peace"

In total, the faculty lecture series drew 1,152 people. The overall press coverage was above average, but due mainly to the efforts of the university"s daily, The Sunflower. There were articles every week. We hoped that all the coverage of the faculty work would also serve to advertise the "Wichita Conference on Peace & War", initiated five days after the final faculty lecture series session. Monday the university media began what we hoped would be a media blitz. On Wednesday, the Wichita Eagle and Beacon previewed the conference, but the television and privately-owned radio stations failed to follow through despite my personal forty-two phone calls to the media alone, and even though our university press releases had been reaching them for weeks. But it is fair to say that besides serving as an end (or collective ends) in itself, the faculty lecture series served to advertise by word of mouth the "Wichita Conference on Peace and War Issues". This was evidenced by the evaluations filled out by the audience.

The knowledge presented in the faculty lecture series stimulated various members of the audience to be in attendance at the "Wichita Conference on Peace and War Issues in a Nuclear Age". Essentially, the first approximation had created "spin offs" while serving as a reference point. While this conference lived up to its academic or scholarly composition, the political leaders (Dole, Kassebaum, and Glickman) balked. One newly-elected City Commissioner, Gary Bell, did attend the session on economic conversion, however. The other group that was conspicuously lacking, policymakers from the Wichita aircraft industry, became overshadowed by the active participation of local and national officers of the International Association of Machinists and Aerospace Workers (Lehman and Greenwood) (7).

The conference broadened and enriched themes introduced at the faculty lecture series, and often went beyond in raising new ideas or questions. Robert J. Lifton spoke about the life adjustments of Hiroshima and Nagasaki victims, but also indicated the need for new ways of thinking and the necessity for reversing the trend toward nuclearism. Joseph Weizenbaum, M.I.T. specialist on artificial intelligence, concurred, but noted that it would take no less than a miracle to delay the Earth"s destruction beyond even this century!

The second session of the conference considered the "Economics of the Arms Race and Problems of Conversion". Joel Yudkin, Director of the National Center for Economic Conversion, encouraged cities like Wichita to shift their economic production from wartime to peacetime. One example was that of Ovation Guitars which had been in the defense contract business.

The third session focused on "Foreign Policy and the Meaning of Defense". This featured Richard Garwin of IBM, noted physicist that helped invent the hydrogen bomb and Adjunct Professor of Cornell, Harvard, and Columbia universities. In addition to the ethical considerations of wiping out humanity on earth, he pointed out the wasted expenditures of overkill, the illogic of using plane geometry principles in "Star Wars", and the twisted figures of the Reagan administration in calculating the costs of such a project.

During the question and answer period, Garwin noted that, with so many illegal drugs being smuggled into the United States and the government"s inability to halt such actions, it would certainly be feasible for foreign agents to smuggle suitcase nuclear bombs into the capitols of either the Soviet Union or the United States.

The fourth session focused on "Prospects of Global Order", and featured Saul Mendlovitz of the World Policy Institute. He reiterated his abolitionist principles and argued that nuclear weapons should be made illegal and that this law should be enforced stringently. He spoke of the need for people to think of themselves as world citizens as opposed to citizens of any one country.

The final session was entitled "Education for Peace and Disarmament". The featured speaker was Douglas Sloan of Columbia Teacher"s College. He talked about the need for education about nuclearism at all levels, but especially in teacher education. Sloan suggested that even though teacher education programs have acted slowly, and often only peripherally, peace and war issues must become the crux of all education. Education must begin to examine the qualitative concerns about human life, thus avoiding that line of reasoning that addresses only the quantitative.

One key aspect of the final session was the treatment of media as education. Therefore, Gilbert Cranberg, George S. Gallup Professor of Journalism, The University of Iowa and Martin Umansky, Chairman of the Board of KAKE the Wichita ABC television affiliate also made presentations. This theme generated one of the more critical discussions produced in the conference. Of prime consideration is the anti-democratic potential of nuclear weapons as most citizens are excluded from nuclear policy processes and power becomes concentrated in the hands of a few groups and individuals.

The point is: can the media as education help restore democratic decisionmaking by more thorougly educating the masses and thereby reduce the dangerous tendencies toward nuclearism? Others have argued that:

> "...a widespread campaign to provide citizens of all ages with information about nuclear weapons issues will generate numerous benefits. Awareness of the threat will widen and deepen. Citizens will obtain information necessary to evaluate policies and proposals about nuclear weapons. They will also be able to judge political candidates on the basis of facts rather than campaign rhetoric. Education will help identify and dislodge the forces of nuclearism, which thrive when the citizenry is ignorant, apathetic, and content to leave national security to

> the "experts." Furthermore, the healthy functioning of our democratic political institutions, which depend upon a citizenry well-informed about crucial issues, will be enhanced. Creative analysis of possible solutions--the "new thinking" for which Einstein pleades--will also be enhanced. Demand and support will increase for alternative national security policies that are less likely than present ones to lead to nuclear war. Finally, the denial and psychic numbing that interfere with confrontation and action will be counteracted by a sense of shared concern and by an awareness of possibilities for reform" (8).

Radio, television, newspapers and other journals may act as informal channels of education, leading or supporting the formal institutions. One question raised considered the possibilities of self-imposed censorship by the media over such controversial issues as the economic conversion of a city like Wichita. Therefore, the role of media as educational agents must not be considered automatic or necessarily constructive, but its power should not be overlooked in provoking the imaginations of humankind.

There has never been an educational aim as necessary as that of living in the nuclear age. The need for universities and public schools to act to make a difference has never been greater in view of the unprecedented challenges of nuclear technologies. Experience and knowledge are the bases of the idea that wisdom is strength. Ethical responsibility requires human choice, and education can provide alternative choices pertaining to the prevention of nuclear war. All levels of education can make interdisciplinary examinations of peace and war. Education with cultural action in these projects was aimed at using the media for two broad purposes: (a) reaching members of the community in the here and now and (b) recording speeches and dialogues for future utilization in the classroom or by broadcast in the local community. National and international networking for wider impact have become part of the process as the projects were developed.

Evaluating the impact upon the community requires a general appraisal and some specific examples should be delineated. Based upon attendance figures and comments from the evaluation forms, more than 2,000 people were at the various events: 1,152 (Faculty Lecture Series) +157 (Central America Today) +728 (Wichita Conference on Peace and War)= 2,037 total. Members of the audience had various opportunities to discuss issues and ask questions of scholars. The national and international participants also gained new knowledge. The evaluations also indicated that the humanities were vital to the successes of the projects and contributed to the elevation of public awareness of all in attendance.

One of the most effective components of both conferences was the utilization of local people. The interdisciplinary aspects contributed to the overall success by allowing a variety of perspectives to be examined. In addition to reaching members of the community directly, electronic documentation of the events will be useful in future classroom use and radio or television broadcast. Resources which resulted include:
1) reel-to-reel audio
2) audio casette masters for the processing of high-speed copies
3) 3/4 inch video for archival storage
4) 3/4 inch video masters for duplication
5) 1/2 inch copies for educational use
The video are in color and the 3/4 inch tapes are broadcast quality (with slight re-formatting and minimal editing).

Here are some specific ways that the electronic documentation has had or may have impact in the immediate future:
1) Use in a computer science class
2) support for a foundations of educations class
3) plans to air audio on campus radio beginning in August
4) extended national and international networking for wider impact and media distribution (Cambridge Forum, World Policy Institute, Films International Inc., etc.)
5) use in a variety of classes this academic year, including the possibility of airing the conferences on campus television.
These media could help younger generations to see that active participation and hard work may bring humanity closer to peace. These media are an indication that nuclear war would be the failure of human wisdom. Hopefully, these media will contribute to peace and world order education, inquiry that "is value-oriented, seeking to motivate students to work toward the implementation of world order values--peace, social justice, economic well-being and ecological balance" (9).

The impact thus far is admittedly limited, but gaining the attention of one inquiring mind is qualitative in addition to being quantitative. Ideas, values, and purposes from a wide variety of human experience did help some imaginative minds to inquire about new possibilities. Some inquired "Who are we that we can possibly develop technology to the destructive endpoint of all humanity?" Others asked "What actions might really make a difference?" Critical analysis searched for answers, but often only raised more questions.

On the other hand, the impact must not be sold short. Many ideas were shared in the interchange of free thinking. Locally, two dozen professors will provide interdisciplinary themes generated in these projects to their own disciplines and further their own research. Plans are underway for new course offerings within disciplines that may one day be arranged into a Peace Studies Program, and perhaps an Institute for Peace Research will be established as early as next year. Another significant impact at the local level is the linking nature with peace groups, churches, and other universities and institutes. One additional impact must not go without mention. The local school district provided an audience of secondary youth on one occasion which many professors and teachers cooperated in for the purpose of accelerating peace education into the schools. The local school district made video recordings and plans to air the session on their three television stations this autumn.

It would be easy to rest on our laurels, but if any further long-term impact is to take hold it will be up to the people to continue with active involvement in groups to which they already belong. Individuals may have to form newer groups and innovate old institutional organizations, but there is room for hope if we just give peace a chance. Involving politicians and members of the military could very likely help speed the processes along. One thing for certain is: peace is no easy task. Winning over the vested interests will be extremely slow until the people help the military-industrial complex to see that a peaceful world must be their first interest lest we destroy ourselves.

Notes

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5. New York Times, "Protest or Debate," April 18, 1982.
6. See Appendix I, a list of the Wichita State University 1985 Faculty Lecture Series on War and Peace.

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NATIONWIDE INFORMATION TECHNOLOGY AND INITIATION IN THE INFORMATION TECHNOLOGY: A COMPARISON BETWEEN THE NETHERLANDS AND BELGIUM

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België - Nederland

1. Introduction

In the Netherlands as well as in Belgium the computer nowadays finds its way in great numbers in primary and especially in secondary education. Many schools have purchased a computer for the administration, for the pupils, or because the teachers thought it so amusing. About the secondary education we see the first applications of the computer emerge with those subjects, by which already some affinity to the computer is expected from the teachers: mathematics and biology, information technology and information assimilation. There is the danger that the "computer science" (see "nationwide information technology" for the Netherlands and "initiation in the information technology" for Belgium) will only find a place within the technological beta-perspective. At the moment, however, the computer has such an influence on society, that one night as well consider this subject-matter of teaching as part of the social sciences. The consequence for the school is that henceforth "computer science" forms part of the general education, which quite recently occurs in the curricula of secondary education in the Netherlands (see "2") as well as in Belgium (see "3"). However, it is to be expected, at least for the next few years, that this innovation as well as the use of the computer in the learning process (see "computer assisted instruction") will be introduced rather slowly and in a limited sense in primary and in secondary education. The infrastructure, for example of the fixed time-tables, together with the generally known financial restrictions the in-service training of interested teachers, as well as the development of educative software, make it very likely that for many impatient children the computer will indeed in the first instance be labeled with the inscription: "you may look at it, but don"t touch".

2. The Netherlands: Nationwide Information Technology

The addition of "nationwide" in the meaning of "information technology for everybody at school", the introduction into information technology is for the time being given the first years (or common years) of secondary education.
The general goal of civil information technology is to enable the pupil to:
a. react with insight upon the situations in which the use of informationassimilating systems is possible or necessary;
b. to judge the social significance critically.

At present we distinguish four main parts:

1. Information processing: learning to use information e.g.
- knowledge of the techniques used in the production and search for information (some of this can be geared to the use of data processing systems);
- insight into man"s role in the provision of information;
- skills about the information processing: e.g. to be able to collect, store, process, present, select, distribute data and to be able to compose messages.

2. Computer Science: learning to use the computer e.g.
- knowledge of concepts such as computer, process, programme, algorithm, processor, memory, input, output, process steering, process storage, data processing, programming language and knowledge of the principles of the structure of software and hardware;
- insight into the phenomenon that computers are pieces of apparatus which are programmed or can be programmed;
- skills about the information processing with the help of computer, and to be able to design algorithms which are necessary to enable the computer to carry out instructions.

3. Applications of new information technology:
- knowledge of the historical development "from abacus to all-round computer", of the occupations in new-information technology, of applications in office and business, industry and commerce, traffic/transport, education and science, public institutions and authorities, leisure time/at home, etc.;
- insight into the scope and limitation of new information technology;
- skills e.g. to be able to use the mast frequently occuring programme applications, word processor, databank, administrative programmes, and to be able to communicate with other computers, especially Viditel.

4. Social relevance: the aim is that student learn to react adequately to the use of computers in society.
- knowledge of the social relevance in the present as well as in the past and the future of the quality of work, employement, occupations, the relationship, public/authorities, etc.;
- insight into the consequences of the (potential) use of computers for man and society;
- social skills based on the correct knowledge of new information technology.

Information technology may constitute a separate subject, but it may also be a subject-exceeding or a general educative theme in mathematics and general techniques, as the government would have it.
Also the computer with its input and output devices and the software play a important part.
For the schoolyear 1984-"85 a strong impuls has been given in the Netherlands to nationwide information technology, by a project involving over 100 schools, which during the following schoolyear will be extended to 200 schools. To this purpose several institutes work closeby together:

- The Dutch Institute for Audio-Visual Media ("N.I.A.M., Nederlands Instituut voor Audio-visuele Media"), is the owner of the units of apparatus, which are sent to the participating schools. The N.I.A.M. also keeps the units of apparatus in repair.

- The National Foundation for Curriculum Development ("S.L.O., Stichting Leerplanontwikkeling"), develops curricula in co-operation with the Centre for Education and Information Technology ("C.O.I., Centrum voor Onderwijs en Informatietechnologie"), and provides educative software for the use of the project-schools.

- The National Centres for Education ("L.P.C., Landelijke Pedagogische Centra"s), The New Teachers" Training (N.L.O., Nieuwe Leraren Opleidingen") and the in-service training institutes provide an instruction-book for the use of teachers who are eligible for teaching nationwide information technology.

The most important consideration in the choice of about 100 schools is the high degree of differentiation in the project towards school types (see for example the generally educative schools MAVO, HAVO, VWO; the vocational educative schools LTO, LHNO, LEAD, LAD; and the comprehensive secondary school), teachers for different subjects and schools with and

without experience in teaching information technology.
Another point of consideration in view of stipulating a policy is the evaluation after the first schoolyear, i.e. in what way experience has been gained in these schools with the available units of apparatus and software.
Subject-matter and educative software (courseware) were supplied by, among others, the Foundation of Curriculum Development edited a series "Brochures". This trend will be continued by agreements with the educational publishing-companies that manage to combine the treatment of subject-matter with the know-how of information technology.
The training of the teachers involved in the 100-schools-project took place in autumm 1983 in the fused institutes of the "New Teachers" Training" (N.L.O., "Nieuwe Lerarenopleiding"). It was handled systematically, also with respect to the continuous in-service training, and always in close contact with the schools (close to the practice).
This close co-operation of all these involved together with a great deal of personal dedication is a necessity in order to be able to work, in a time of cutting down expences, within the limited possibilities. This is also the reason why the Ministry of Education and Science co-operates with the Ministry of Economic Affairs. The latter ministry thinks it a good thing that knowledge about and skill in information technology become common coin.

3. Belgium: Initiation in information technology

In Belgium the board of education has decided to introduce, for the nexts schoolyears in the state schools and in the independent schools, a course "Initiation in information technology" for all pupils between 15 and 17 years in the 3rd, 4th and/or 5th classes of secondary education.

The contents and goals of the initiation in information technology are formulated by prof. G. De Corte at the symposium of 1984 in Antwerp. He distinguishes four main parts:

1) Computerarchitecture: an elementary technological knowledge of a computersystem is necessary. This includes basic concepts like data, information and information assimilation. The basic components of a computer system and their specific operation and relations are discussed. This part should rather be looked upon as an introductory, descriptive part, which is necessary to understand the possibilities and limitations of computers, which are discussed in the following parts.

2) Problem-solving thinking: this part is very important because the acquired techniques are also usable in other subjects and in practical situations in every day life. In order to solve a problem one starts with a complete definition of the problem; after that one works out a solving-strategy (making an algorithm or heuristics and one writes it out on a flow-chart).

3) Practical use of the computer: practical use of the computer is also necessary when introducing information technology, because it highly motivates the pupils and because the subject must have interfaces with the reality of computer-use (cf. the role of experiments by pupils in teaching physics, language-lessons by computer, information assimilation, etc.
In certain sections it is even necessary that one deals only with a limited number of software applications and no "real" programme-language. In the section secretary-modern languages, for example, an introduction to text-assimilation, databanks, electronic mail facilities etc. is important and also links up closely with the comprehension and interest of the pupil.

4) Social implications: in this part the information technology is situated in its social context. Beside the effects of the information technology on society as a whole, the effects for individuals and groups are also dealt with. It is the purpose to bring the pupils into contact with situations in which the information technology has, has had or will have an influence on social structures. The pupils must be stimulated to think about the causes and effects of these situations and to take a stand towards the influences of information technology on the social, economic and political level.

From the schoolyears 1985-1986 and 1986-1987 onwards all pupils between 15 and 17 yaers of the 3rd, 4th and 5th classes of secondary school will receive an initiation in information technology. In the past year informing experiences have been acquired in the 15 pilot schools and will be continued next year in a hundred experimental schools of several types. One condition that was made was among other things that at least one teacher of information technology should not be a mathematician and not an economist. This for two reasons. On the one hand to achieve a prompter integration in all subjects of the following years and on the other hand to have less difficulties in inserting (examples from the different disciplines) in this 4th year of secondary school.
From September 1984 onwards also a start has been made with an in-service training programme for teachers, in co-operation with

the universities in Antwerp, Brussels, Ghent and Leuven, in which for the Dutchspeaking part of the country a thousand teachers participate, who are eligible for teaching this initiation in the information technology.

The procedure is as follows. During the months October and November 1984 some 20 teachers secondary education received an "intensive in-service training course" at four Flemish universities. These teachers are what the French call so pithy the "formateurs des formateurs". In their turn they have to train all their colleagues who will have to teach the course "initiation in the information technology". They also have to compose in cooperations with one university teacher-packets in order to have the possibility to fill in this course in an optimum way.
From January 1st this in-service training is obligatory and teachers will have to train themselves in the future for three months every five years.
At this training the emphasis must be put on structural thinking, on algorithms and diagrams of connections as a theoretical input, on a structural programme-language as an application of structural thinking, after the assimilation of the theoretical input, and not on all kinds of machine-technical specifications.
This explains why this initiation is introduced also in the fourth and fifth year. Because already fair demands are made upon the intellectual capacity of the pupils and when the pupils are too young this subject must lack the necessary depth.
In his speech on the symposium of 1984 in Antwerp, the Minister of Education, D.Coens, asked also the question whether the information technology ought to be considered as a separate subject, or as a way of thinking and dealing with resources that have to be included in all teaching-activities. According to the minister the application of the information technology must penetrate into the entire curriculum and the inforamtion technology must be introduced as early as possible - this means also in primary education. So, information technology should not be considered only as a separate subject, but from the start it should be situated in a broader or general-educative context and should be integrated in other subjects. He even wants to go a bit further and, whereas the information technology will first only taught from the 3rd and 4th years of secondary school onwards, he wants to extend this to the 1st and 2nd years (observation-grades) in the subject "technological education". The present stagnancy in this subject must be converted as quickly as possible into a modern and efficient survey of the technological thinking and the technological systems.
This means that after the introduction of the subject "Initiation in the information technology" adaptions in the curricula of the other

subjects may be expected and that all teachers in the long run have to receive an in-service training information-technology in general and about specific applications of it in their subject. Up to now 60.000 secondary schoolteachers and 7.000 teachers of higher education from state and independent schools are going to be in-service trained.

4. Some conclusions regarding the comparison.

- Both countries start with computer science (although the difference in name-giving) as a subject-matter of teaching in secondary education. The Netherlands close the first year, whereas Belgium aims at the 3rd, 4th or 5th year of secondary education.
- The goals are the same in the Netherlands as well as in Belgium. The Netherlands put a somewhat stronger emphasis on a social-critical assessment and Belgium attaches greater importance to making algorithms and heuristics in view of solving problems and accurately making diagrams of connections or "flow-charts".
- The intention to treat this subject-matter as a separate course is greater in the Netherlands than in Belgium. But to be true the government stimulates general education. In the Netherlands there is a stronger affinity to mathematics and general techniques (see technological education for Belgium), whereas Belgium wants to keep this choice wider and tries to give also other teachers an in-service training.
- The Netherlands started a few years earlier than Belgium with the formation of committees, foundations (see the C.O.I.), the in-service training of teachers, and the 100-schools-project for a large variety of school types. Belgium thinks to be able to catch up by a snowball-innovation-strategy. For example, teachers that have received an inservice training at the university will instruct other teachers in pedagogic and didactic centra in the region.
- The agreements for co-operation, made by ministries and supporting institutes, are more frequent in the Netherlands than in Belgium. See for example the co-operation between the Ministry of Education and Sciences and the Ministry of Economic Affairs, N.I.A.M., S.L.O., C.O.I., The National Centres for Education and the New Teachers" Training. In Belgium these foundations are either not created or limited in financial means (see for example the subsidization of the didactic centres for the independent schools). A high degree of support is given to the free initiative of teachers and

schools. In Belgium it is also a tradition with a lot of school projects to aim first at the universities. Leuven with regard to catholic education, the State universities with regard to the state schools; Antwerp and Brussels aim at a wider range of schools, for example also at the provincial and municipal schools.

- The Netherlands are, thanks to the support of the Foundation for Curriculum Development, better provided for the development of educative software than Belgium, where indeed the universities have developed a lot of materials on the scientific level. In the Netherlands the emphasis lies more on an implementation of the "Quires" in close relation to practice, while in Belgium the teachers are left on their own with the given materials.
- The Netherlands only made a provisional planning (evaluation after the schoolyear 1984-"85 about the 100-schools-project) and Belgium aimed from the start at a greater diffusion in the next few years and an in-service training for all teachers. Yet in both countries there is apparently a planning from the top. Within the independent education in Belgium there are, however, many marks of personal initiative (also with respect to the support of the catholic university of Leuven), that indicate an innovationstrategy from below.

DIE UNTERSCHIEDLICHE CHARAKTERISIERUNG DES SCHULEINGRIFFS IN NORD- UND SUEDITALIEN IN BEZUG AUF DIE BERUFSAUSBILDUNG

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Der Unterschied zwischen Nord- und Süditalien hinsichtlich der ökonomischen und industriellen Entwicklung ist allgemein bekannt, aber auf noch beunruhigendere Weise macht er sich auf dem Gebiet der Schulausbildung bemerkbar.
Die Verbreitung der Technologien in den verschiedenen Arbeitstätigkeiten hat vor allem auch eine verschiedene Charakterisierung: a) bezüglich der individuellen Ausbildung
und b) bezüglich der Schulprogramme notwendig gemacht.

Hinsichtlich der persönlichen Ausbildung kann man nicht umhin, immer noch eine deutliche Unterschiedlichkeit der Tendenzen wahrzunehmen, die in den zwei grossen sozialgeographischen Gebieten Italiens verfolgt werden. Besonders in den Gegenden, wo der Fortschritt der Industrialisierung und des Tertiärbereichs unverkennbar ist, haben die Anforderungen des Arbeitsmarkts Ausbildungswahlen bestimmt, die eine weitgehende Anwesenheit derjenigen Technologien voraussehen, in deren Wirkungsbereich sich aussergewöhnliche Berufschancen bieten werden.

Die Qualität des Arbeitsangebots steht in Wechselbeziehing zu der Qualität der Ausbildungsmöglichkeiten in den verschiedenen territorialen Realitäten und bestimmt deshalb in den technologisch wenig entwickelten Gebieten überwiegend Formen von Unkultur, wo die Ausbildung hauptsächlich als eine Aneignung allgemeiner Kenntnisse humanistisch-literarischer Tendenz betrachtet wird.

Die grösste Gefahr ist offensichtlich diejenige, dass sich immer mehr die Figur eines südlichen Intellektuellen herauskristallisiert, der im Grunde von der produktiven Realität abgeschnitten ist, und der in nächster Zukunft vielleicht auch grosse Schwierigkeiten haben wird, konkrete Beiträge für die kulturelle Entwicklung Süditaliens zu liefern.

In den südlichen Schulstrategien bemerkt man weiterhin einen verbreiteten Vorzug für die Ausbildungskurse, deren Programme keine Investitionen in anspruchsvollen Technologien erfordern. Diese Tendenz scheint durch das zahlreiche Vorhandensein von Lehrerbildungsanstalten und humanistischen Gymnasien im Süden bestätigt zu werden, wo auch die Anzahl derer, die in humanistischen Fächern promovieren, überwiegt.

Andererseits sind in Norditalien mehr die technischen Berufsschulen verbreitet, für deren Finanzierung, sowie für deren Versorgung mit technologischen Vorrichtungen des öfteren teilweise oder auch hundertprozentig die lokalen Industrien aufkommen.

Nach dieser kurzen Beschreibung der unterschiedlichen Lage im Norden und im Süden versuchen wir gründlicher die soziale, ökonomische und kulturelle Situation zu sondieren, nicht nur um Daten zu sammeln, sondern auch um Mittel und Wege zu finden, um ein altes Problem zu lösen, das zutiefst die ganze Bevölkerung und Schulgemeinschaft des Südens in Mitleidenschaft zieht.

Betreffs der schon erwähnten Beziehung zwischen technologischen Neuerungen (von denen wir hoffen, dass sie sich in kurzem auch im Süden verbreiten werden) und Ausbildung, haben wir bemerkt, dass im Norden ein aktives Ferment von Ideen besteht, das sich auch in Tatsachen umsetzt, im Süden, dagegen, der Geist unweigerlich eine Neigung zu den humanistischen Studien zeigt; zu dieser Wahl führt, wie gesagt, schon allein der Umstand, dass die humanistischen Schulen überwiegen, während die technischen Berufsschulen mangeln, vielleicht aber auch hauptsächlich die noch immer bestehende tiefe Verbundenheit mit den humanistischen Studien und eine geheime Furcht, dass die Technologie, in Konkurrenz mit der traditionellen humanistischen interpersonellen Ausbildung, diese letztere ganz verdrängen könnte.

So wie die Dinge liegen, scheint es unerlässlich, dass diese Ideen revidiert werden, dass man zu neuen Erziehungsmethoden greift und die öffentliche Meinung von der Notwendigkeit der Einführung und des Gebrauchs der neuen Möglichkeiten überzeugt, die von den hochentwickelten Formen der Technologie angeboten werden, und dass man die Lehrer durch gezielte Fortbildungskurse dazubringt, dass sie nicht nur mit dem Gebrauch des Computers vertraut werden, sondern auch fähig sind, mit hilfe des Computers die didaktischen pädagogischen Ziele der Pflichtschule zu verfolgen.

Im Süden mangelt es weder an Massenpropaganda noch an Information, welche zweifellos Interesse und Neugierde weckt; aber bis jetzt ist noch kaum etwas in die Praxis umgesetzt worden.

Betrachten wir dagegen die anderen Nationen - USA, England, Frankreich, Deutschland oder Japan - so sieht man, dass sich der Computer dort schon in einer fortgeschrittenen Phase befindet. In Italien wurde er experimentell 1968 eingeführt; die Informatik allein als Unterrichtsfach für die technischen Hochschulen, wurde um 1972/73 formalisiert. In den Ministerialprogrammen ist das ganze jedoch noch im Projekt und in den Mittelschulen kommen wir seit 1979 nicht über Unternehmen hinaus, die von dem Gutdenken der einzelnen Lehrkörper abhängen. Es scheint jedoch, dass mit dem gegenwärtigen Reformprojekt der höheren Schulen, dem Artikel 4 - Area delle discipline comuni - man eine Realisierung der Bildungsziele anstrebt, die die allen Ausbildungsrichtungen gemeinsamen Informations- und Mitteilungssysteme betreffen. Wir können nicht umhin, dieses Reformprojekt zu begrüssen und hoffen, trotz der nur allzubekannten Langsamkeit und Umständlichkeit unserer Bürokratie, auf eine effektive und baldige Verwirklichung.

Trotzdem weckt die Aussicht auf ein von den Regierungsbehörden ausgearbeitetes Programm einer technisch-didaktischen Neugestaltung eine gewisse Perplexität. Die Kluft zwischen Nord- und Süditalien ist gross, und man könnte sagen fast ohne irgendeine ernstzunehmende Aussicht auf künftige Wechselbeziehung.

Dies wird schon von der Geschichte bestätigt. In der Vergangenheit haben des öfteren dramatische historische Ereignisse unseren Süden heimgesucht, der, obwohl reich an Intelligenz, Humanität, Grosszügigkeit, Opferbereitschaft und Unternehmungsgeist, häufig die habgierigen Invasionen van skrupellosen Völkern und die Tyrannei von kurzsichtigen Regierungen ertragen musste.

Der einzige Reichtum, der nie die Bevölkerung im Stich gelassen hat, und der sie ernähren konnte, ist die Landwirtschaft, die mit primitiven und althergebrachten Mitteln betrieben wurde.

Der hohe Grad von Analphabetismus ist erst in dieser unserer Epoche fast ganz überwunden worden.

Aber die Schule hat sich noch nicht den neuen Zeiten angepasst. Sie ist nicht fähig, qualifiziertes Personal für die wissenschaftliche und technologische Forschung auszubilden. Dies schafft eine Situation von Zweitrangigkeit gegenüber den fortgeschritteneren nördlichen Gebieten und ruft auch in den Gemütern der südlichen Bevölkerung ein Gefühl von erniedrigender Unterlegenheit, des öfteren auch von Resignation hervor, und was schlimmer ist, zuweilen eine Rebellion, die in die verschiedensten Arten von gesetzeswidrigen Handlungen ausartet - Schmuggel, Verbrecherbanden, Mafia, Kamorra, etc. -.

Es handelt sich hier folglich nicht nur um ein pädagogisches, sondern auch um ein politisches und sozialökonomisches Problem, das hoffentlich baldigst eine definitive Lösung findet, um die augenblicklichen Ungleichheiten zwischen den Regionen zu überwinden, und in der ganzen Nation einen Zustand von Gleichheit zu schaffen.

Aber die von allen erwartete und erwünschte Neuerung kann nur durch die Lösung der Schulsituation verwirklicht werden, wobei viel von der öffentlichen und privaten Initiative abhängt.

Man kann nicht leugnen, dass seit dem II. Weltkrieg sich die Lage ein wenig verändert hat und diese Entwicklung, auch wenn nur im beschränkten Masse, im ganzen Süden weiterfortfährt. Neue Erkenntnisse haben auch hier Eingang gefunden, langsam flaut die Auswanderungswelle ab. Ob dies von einer neuen Möglichkeit abhängt, im Süden selbst Arbeit zu finden, oder von den Einschränkungsmassnahmen, die die Gastländer erlassen haben, bleibt dahingestellt.

Trotzdem wird im Süden immer noch sehr wenig getan für die Landwirtschaft und um den natürlichen Reichtum, der hier in so hohem Masse vorhanden ist, besser auszunützen. Und wieder müssen wir vom Schulproblem reden, denn woher, wenn nicht von der Schule, kann die Möglichkeit einer Neuerung kommen? In der Schule werden die Generationen von Technikern, Forschern und Facharbeitern ausgebildet. In der Schule werden die Männer von morgen auf ihren Beruf vorbereitet.

Aber nochmals möchten wir auch auf unsere Ueberzeugung hinweisen, dass im Süden das Substrat von humanistischer Kultur weder unterschätzt noch ignoriert werden sollte, unter anderem auch wegen des eventuellen Beitrags dieser Kultur für eine harmonische Bildung von Menschen, die alle Vorteile der modernen Erfindungen mit dem von den antiken griechisch-römischen Kulturvölkern ererbten Gut in Einklang bringen könnten.

Die neuen Technologien dürfen nicht als Ersatz für die humanistische Kultur betrachtet werden: die Technologie muss immer höheren, nicht nur materialistisch ausgerichteten Willen gehorchen, einer Ethik untergeordnet sein.

Im Süden widerspiegeln sich die ewigen Werte im humanistischen Bildungsideal. Ohne kann man es nicht auskommen.

Wir können auch nicht leugnen, dass die Menschkeit entschieden einen "Fortschritt" machte, als auf die philosophische Weisheit Platos das Wort von Christus folgte das einen neuen revolutionären Begriff der brüderlichen Solidarität unter den Menschen verbreitete, welcher klar die Grundlinien des Anspruchs aller Menschen auf Recht und Würde umriss, ohne Rücksicht auf Rasse, Hautfarbe und sozialen Status: die christliche Karitas verbreitete sich auf der Erde für jede menschliche und bürgerliche Anerkennung in einem Staate, der die Rechte des Einzelnen und aller Menschen verteidigt.

In diesem Zusammenhang muss jeder Fortschritt der Wissenschaft und jede technologische Entdeckung kein Vorrecht für den Einzelnen, sondern ein Mittel für eine gerechtere Verteilung der gemeinsamen Güter bedeuten. Wenn diesen Grundprinzipien keine Beachtung geschenkt wird, entstehen Missverhältnisse, die im Menschen Angst, Unsicherheit, Einsamkeitsgefühle und Kontaktarmut aufkommen lassen, und die ihn leicht zum Opfer eines unruhigen und tragischen Lebens machen.

Der Mensch im Weltraum wird sicher dieselben Aengste, dasselbe Gefühl von Einsamkeit empfinden wie der Mensch Homers und der Mensch in der Bibel.

Im Süden wird dieses Drama von Neuem durchlebt. Der Süden erkennt, und dies ungeheuer intensiv, und gerade auf Grund seines jahrhundertealten Schatzes an humanistischen Kenntnissen die seine Sensibilität geschärft haben, dass es keine gleiche Behandlung vom Norden und Süden geben kann, dass ein klarer Vorzug immer den Norden zukommen wird, der nach wie vor in industrieller und technologischer Hinsicht führend sein wird, und er fühlt sich als Opfer einer unterschiedlichen Behandlung von seiten der politischen Klasse, deren Handeln des öfteren von unverständlichen Interessen bestimmt wird.

Aber der Mensch des Südens fürchtet nicht die geschichtliche Nemesis. Er reagiert und zwar mit Intelligenz. In der Tat, in einem Moment, den man auf den ersten Blick statisch nennen könnte, bemerkt man Anzeichen von neuen Bemühungen, es auf wissenschaftlich-technologischem Gebiet mit den anderen Regionen Italiens aufzunehmen. Auch wenn die humanistischen Studien weiterhin sehr beliebt sind, nimmt doch die Anzahl der technischen Berufsschulen zu, welche reichlich von Studenten besucht werden, deren Wahl auf Berufe gefallen ist die sie in ein weitfortgeschrittenes Arbeitsgebiet führen werden.

Aber hier präsentieren sich nun die folgenden Situationen:

a) Die ungenügende Vorbereitung der Lehrer macht sie unfähig sich der Lehrmittel zu bedienen mit deren Hilfe sie den Ausbildenden einen angemessenen Unterricht erteilen könnten;

b) in technischen Berufsschulen, denen es an Laboratorien und Geräten fehlt, können selbst technologisch gut augebildete Lehrer den Studenten nur einen rein theoretischen Unterricht erteilen;

c) und sollte es eventuell vorkommen, dass technisch begabte Studenten eine Schule besuchen können die sowohl über geeignetes Lehrpersonal als auch über die fortschrittlichsten technologischen Geräte verfügt, so sind die Chancen nach der Ausbildungszeit hier im Süden einen geeigneten Arbeitsplatz zu finden doch sehr gering, da es an Industrien fehlt.

Der Süden betrachtet das nördliche Modell als ein Beispiel, dem man nacheifern muss. Viele von unseren grössten Genies, die in den Norden oder ins Ausland ausgewandert wind, haben dort wertvolle Beiträge auf dem Gebiet der Wissenschaft und der Technik geliefert. Aber wieviele von diesen Wissenschaftlern hegen nicht im geheimen den Wunsch im eigenen Land, in ihrer Heimat, arbeiten zu können, da sie ihre Wurzeln in jenem Boden haben, mit dem sie eine atavistische Tradition verbindet. Und wir erhoffen uns von den Männern, in deren Händen die Führung unseres Staates liegt, dass sie mit Gerechtigkeit und Einsicht gleichmässig in allen Gegenden Italiens, von Norden bis zum Süden, die notwendigen Mittel zur Entwicklung und zum Ausbau verteilen, ohne die Wahrung der kulturellen und historischen Gegebenheiten und der Umweltsbedingungen ausser Acht zu lassen.

Zum Abschluss dieser kurzen Untersuchung über die Kluft, die augenblicklich Norditalien von Süditalien trennt, sei mir noch eine Betrachtung erlaubt: ungeheuer gross ist das Verlangen einer neuen Welt der Wissenschaft und der Technik weit die Türen zu öffnen; von der Technologie sagt man, dass sie im Dienst der Menschkeit stehe, um dieser einen höheren Lebensstandard zu erlauben, um die Unternehmen des Menschen in einer Welt, die ihm grossenteils noch unbekannt ist, zu erleichtern, um perfekte Instrumente herzustellen, mit denen er die Naturkräfte seiner unbegrenzten Macht unterwerfen kann.

Aber hier zeigt sich noch einmal als unersetzbar in der Welt des Menschen und der Gesellschaft der erzieherische Wert der Schule, und wir möchten ganz besonders auf den dauernden erzieherischen Wert hinweisen, den gerade die humanistische Tradizion bieten kann, die im Süden noch so Lebendig ist.

Anlässlich des internationalen Kongresses in der Cini-Stiftung in Venedig, vom 22.-26. Februar 1983, erklärte Mauro Laeng in seinem Beitrag zur "Technologischen Neuerung und Erziehung", dass eine sehr enge Beziehung zwischen den Techniken besteht, mit denen der homo faber versucht hat direkt die Dinge zu beherrschen, und den Sprachen, mit denen der homo sapiens versucht hat, sie indirekt zu manipulieren.

Auf demselben Kongress betonte Emanuele Caruso, dass der Mensch sich nicht darauf beschränkt hat sich (passiv) anzupassen, sondern vielmehr versucht hat (aktiv) die Welt seinen Ansprüchen anzupassen. Wir wollen hier den entscheidenden Uebergang erfassen von einer Art des Lernens durch klassische Konditionierung zu einer anderen Art des Lernens durch instrumentelle Konditionierung. Zwischen den beiden besteht ein immenser Unterschied. Die eine Ursache durch Ursache, die andere, dagegen, Wirkung durch Wirkung; die eine leitet sich vom Determinismus her, die andere erstreckt sich in den Finalismus. Die eine ist Vergangenkeit, die andere ist Zukunft. Aber der Mensch ist Geschichte, also ein direktes Band zwischen Vergangenheit und Zukunft.

Die Welt der Informatik, der Computer und der Roboter hat zu den erstaunlichsten Errungenschaften geführt, denen man zutrauen kann, dass sie nicht nur fähig sind die Arbeit des Menschen zu ersetzen, sondern auch seine Intelligenz. Kann der homo sapiens in einem Zeitalter der Technologie überleben, oder wird seine Intelligenz von der künstlichen Intelligenz verdrängt werden?

George Orwell, der Autor des Zukunftsromans "1984", der zum ersten Mal 1949 veröffentlicht wurde, hatte eine prophetische Vorahnung von der gefährlichen Macht der Wissenschaft in unserer Zeit. Er sah eine Zukunft voraus, in der die Menschheit von der Informatik und von den Computern beherrscht wird.

Aber es ist andererseits sicher keine schlechte Idee, die neuen Technologien in den Dienst der Menschheit zu stellen. Bedienen wir uns also ihrer auch zum Wohl des Erziehungswesens! Der Computer ist äusserst wertvoll in seiner Wechselbeziehung mit dem Operator und gewährt ein unmittelbares feedback, d.h. Rückmeldungen und Verstärkungen der Informationen, was man allgemein von grosser Wichtigkeit für den Lernprozess erachtet.

Unserer Meinung nach ist es angebracht, von den ersten Schulklassen an die Schüler mit den Instrumenten der neuen Wissenschaft vertraut zu machen - ohne sich damit frevlischer Handlungen gegen die Natur schuldig zu machen.

Aber die Erziehung muss wachsam sein, damit die mechanischen Mittel nicht die echten menschlichen Aspekte unterdrücken. Keine Machine wird je die Person des Erziehers in der Beziehung zwischen Lehrer und Schüler ersetzen können. Ziel des Menschen sollte es vielmehr sein, die Maschine als einen Ersatz seiner eigenen menschlichen Natur zu sehen. Die Aufgabe der Erziehung besteht in der Bemühung, in einer ständigen Entwicklung und Fortbildung des Lern- und Forschungsmaterials, die Macht und Stärke des Menschen zu vergrössern; wir halten es deshalb für unerlässlich, genaue psychopädagogische Informationen, die den umwälzenden technologischen Neuerungen entsprechen, unmittelbar am Lernprozess teilhaben zu lassen, und dies besonders damit nich die Werte verloren gehen, die bis heute ein unüberlegtes, hemmungsloses Wirken einiger Spezialgebiete der Wissenschaft verhindern konnten.

Die Errungenschaften unserer Zeit - Telematik, Informatik, Computer, Roboter, Biotechnologie etc. - sind von grosser Wichtigkeit für den Fortschritt der Menschheit, aber ebensosehr benötigt man eine entsprechende pädagogische und erzieherische Information, um das psychophysische und biologische Gleichgewicht des Menschen zu wahren.
Als Mensch des Südens, mit allen Problemen meiner Heimat vertraut und denen nahe, die auf eine Beschäftigung für eine menschenwürdige Existenz hoffen, jeder Neuerung aufgeschlossen, die die Wissenschaft uns für eine ständige Entwicklung bietet, möchte ich noch einmal wiederholen, dass der Süden der Arbeitswelt noch einen Beitrag an Intelligenz und Kraft geben kann, aber auch einen humanistisch ausgerichteten Geist, der imstande ist jeder unkontrollierten Leistungspolitik, die sich fatal auswirken könnte, entgegenzuwirken.

THE CHALLENGE OF MICROELECTRONC REVOLUTION TO SWEDISH EDUCATION: THREE ALTERNATIVE SCENARIOS.

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1. The Postindustrial Society, New Information Technologies and the Educational System.

Advanced industrialized societies and, to some extent, semi-industrialized ones have been steadily evolving towards a post-industrial or information state, where, the "overwhelming majority of service workers are actually engaged in the creation, processing, and distribution of information" (Naisbitt, 1984, p.4). The concept of the postindustrial society as it has been developed by its founder, the Harvard sociologist Daniel Bell (1976) deals primarily with changes in the socio-economic structure: the change from a goods-producing to a service economy, the pre-eminence of the professional and technical classes, and the new relations between theory and empiricism. The postindustrial society or rather the information society, is not any more an idea, but already a reality which becomes more obvious when considering the way in which the economy has been transformed. Indeed, tertiary or service activities, such as transportation, insurance, trade, education, finance, health, governmental activities and recreation are becoming more and more dominant. Farmers, who a hundred years ago constituted more than two-thirds of the total labour force in Sweden, now make up less than five per cent of the workforce. Industrial workers, who as recently as fifty years ago constituted more than fifty per cent of the total labour force, now account for less than twenty-five per cent of the total workforce, and are likely to share the fate of the farmers.

Clearly, the convergence of already existing home-information microtechnologies, such as TV, radios and videos with the microcomputer into an integrated information and communication system "will fuel the information society the way energy-electricity, oil, nuclear- kept the industrial society, water, and brute force- sustained the agricultural society" (Naisbitt, 1984, p.16).

In Sweden, there is a widespread notion that new information technologies are viable agents of economic development, national independence and social change. This notion is closely consistent with the efficiency and effectiveness of the educational system in responding and adapting itself to the new demands of the information society.

To this end, the Swedish State provides considerable resources both to broaden computer literacy programmes to include all pupils and adults and to increase the provision of computer equipment in all schools. Recently, Stockholm's head of finance has announced the allocation of 300 million Skr within the next five years through which every pupil in the lower and upper secondary schools in the area of Stockholm will be supplied with a microcomputer in school. This implies an increase of the present equipment up to 40.000 units, in the city of Stockholm alone by the end of 1990. This is indeed a tremendous increase if we take into account the present distribution of computer equipment in schools indicated in the following table.

Table 1. Computer equipment in Swedish schools from 1982/83 to 1984/85

Level	Year		
	82/83	83/84	84/85
Lower Secondary	2.100	3.000	3.400
Upper Secondary	4.200	5.300	5.800
Adults	1.200	1.500	1.700

Source: J.Lennström, Utbildning med hemdatorer. In Datoranvändning i hushallen DsC 1984: 10 Stockholm: Liber.

It is worth pointing out that only two-thirds of schools in 1984 had computers with an average of 7.3 for every school (Myrberg, 1984). This places Sweden at the top among the most computerized countries in the world, such as the USA and England. In the USA, for instance, 68 per cent of schools had computers in 1983 with 11 computers on average for high schools, 7 for juniors and 3.5 for elementary, this is a total average of 7.1 computers (Market Data Retrieval, 1984).

The home computer market has been also rapidly evolving. In 1984, about 3 to 4 per cent of Swedish households owned some kind of home microcomputer, and it is expected that the number may be increased to more than 40 per cent by the end of the coming decade (Makrakis, 1985). The computerisation process in other sectors has also been significantly advanced as indicated by the results of a large survey which revealed that two million Swedes need computer education, one million use computers in their work and 620.000 every day (SCB, 1985). These figures are quite high considering that the total population of Sweden is not more than 9 million, and clearly indicate that Sweden is becoming one of the most computerised countries in the world.

Education thus has a strategic and vital role to play in bringing the beneficial possibilities of new information technologies to the home, the workplace and the school. How, then, can the educational system respond and help the country as a whole to take full advantage of the potential of new technologies? What changes will be required and what will they provide both to students and adults, so that they may understand what is happening around them and what may happen in the future?

2. Future Studies in Education

Although there is a close relationship between education and social change and although the former should be a viable agent for the latter, educational institutions, educational policies and educationists in general are still characterised by conservatism, reactionism, individualism and presentism. These have been revealed by many sociological and future studies such as those by Pulliam and Bowman (1974), Lortie (1975), Kauffman (1976) and Tafel (1982).

Clearly the fact that pupils at the present time will be entering the most productive and influential stage of their lives in about twenty years from now, stresses the need for future studies in the field of education. Burdin (1974) states that "Education must be futurism - an intellectual and imaginative projection of emerging phenomena and conditions" (p.141). Toffler (1974) also adds that the "ultimate purpose of futurism in education is not to create elegantly complex, well-ordered accurate images of the future, but to help learners cope with real-life crises, opportunities, and perils" (cited in Burdin, 1974, p.143). Obviously, computers and other microelectronic innovations are rapidly changing the nature of work, life-style, values and almost all aspects of our daily lives. These dramatic changes increase the importance of education and demonstrate several needs which will have to be met by schools in the present for preparing the future. They also indicate the need to pursue futures studies in an attempt to shape the future in a desired direction rather than let it be passively shaped for us.

3.The Impact of Computer Technology on Education Modes.

Broadly speaking, educationists have generally agreed upon the threefold taxonomy of education modes, introduced by Coombs and Ahmed (1974), namely, formal, nonformal and informal education. Although there are still difficulties in the way of defining these three modes (LaBelle, 1982, Bhola, 1983), it is widely accepted that there are three major defining characteristics from which definitions can be made: (i) the type of learning and instruction involved, (ii) the organisation of instruction and learning, and (iii) the purpose or intent of the instructional process (Coletta and Holsinger, 1982, cited in Marshall, 1985).

Marshall (1985) points out that traditionally these three modes were defined in such a way that formal education was mostly focused upon knowledge, nonformal upon skill-generation and informal upon attitude. How, then, will the widespread introduction of computers into the school, the home and the workplace affect these three modes of educational transmission?

In recent times, formal education has been heavily criticized (Edwards and Todaro, 1974, Husén, 1979 and 1980, Simmon, 1981 and King, 1982), and there is general agreement that it failed to give a return for a heavy investment put into it. The crisis of formal education both in industrialised and developing countries made policy-makers and educational planners consider nonformal education as an alternative educational strategy in terms of economic returns, human development and national development plans. The continuous inefficiency of formal education in meeting educational needs and goals as well as in keeping pace with labour market needs has been used as a basis for many social, educational and futures researchers to question the very existence of formal schooling (Husén, 1971, Wilson, 1979, Evans, 1979, Dunn, 1983).

In Sweden, the nonformal educational sector is growing fast, especially in the area of new information technologies, mainly due to the inability of the formal sector to respond to the labour market needs in basic, further and specialized training. The most dominant computer firms in Sweden, such as IBM, Luxor, Esselte, Apple and others, give both basic and specialized training in computers to more than 50.000 people per year (Makrakis, 1985). Also, the total volume of training relating to new information technologies within firms in 1983, has been estimated to be about 100.000 pupil days. This training, to a large extent, aimed at the 35.000 specialists in the field of new information technologies (Myrberg, 1984).

A recent development that has been basically facilitated by new information technologies is distance education. There is a variety of definitions concerning this type of educational transmission that can be found simultaneously in conflict, harmony or both (Peters, 1971, Keegan, 1980 a-b, Baath, 1981, Willén, 1981). In general, there seem to be two main directions representing different schools of thought on distance education, "one stressing individual study and individual, non-contiguous tuturing on the basis of course materials produced for large groups of students, the other aiming at parallelism with resistent study and usually including class or group teaching face to face as a regular element" (Holmberg, 1985, p.3).Broadly speaking, what really makes distance education different from other types of education, is that educational opportunity is available to a large number of people at all levels and ages, in any place and at any time. The following table shows the extent to which educational microtechnologies were used for distance learning in 36 out of 194 organisations that offered distance education in the USA, UK, Australia, Canada, FRG, and Poland.

Table 2. Numbers and percentages of educational microtechnologies used on distance education.

Radio	TV	Printed course units	Audio casset	Video	Films
11	16	35	25	14	8
5.7%	8.3%	18%	12.9%	7.2%	4.1%

Slides	Comput.teaching & instruction	Tel.	Face to face session	Other media
12	9	20	27	2
6.2%	4.6%	10.3%	14.1%	1.6%

The convergence of the microcomputer with other educational microtechnologies, especially video and TV, will clearly open tremendous possibilities for education at a distance which may change the whole educational landscape. It becomes, therefore, apparent that the inefficiency of the formal educational system in keeping pace with the labour market needs in a rapidly changing world, along with the widespread adoption of advanced microtechnologies in individualized and distance learning, will force a reconsideration of the existing organizational structures in the field of education and render superfluous the traditional distinctions of formal, nonformal and informal education modes.

4. Three Alternative Future Scenarios of the Impact of Computer Technology on Education Modes.

4.1. Optimistic.

Over the next two decades all compulsory and upper-secondary schools in Sweden will be adequately supplied with microcomputer equipment. The allocation of microcomputers will be in proportion to the number of students in each school without discrimination between regional and urban districts, deprived and privileged areas. In addition, every citizen will have access to buy his/her own microcomputer and this accessibility will be reinforced by the increasing availability of good quality software adapted to homecomputers. Educational microcomputing at home will be widespread, greatly facilitated by the link of home-computers (HC) and educational computersystems to a central service network, so enhancing the potential use of microcomputers for educational purposes. These changes will open the channels of knowledge to students and other owners of HC, encompassing all Swedisch households. (Where there are economic obstacles to the acquisition of HC, either by students or families, the state will provide assistance through subsidies or tax-relief). As a result formal schools will no longer have the monopoly of knowledge transmission. This, of course, does not mean that their importance will be reduced. On the contrary, due to the wide diffusion of microcomputers partly used for education, it will result in the transfer of certain educational functions from school to the home, the development of individualized and distant learning, so increasing the effectiveness and efficiency of formal education. Consequently, the home will become a "free learning centre" or a "preparatory school" linked to educational computers, in which the student will have access to various kinds of data banks and where he will work individually on his school courses and assignments. The potential benefits of distance and individualized learning will include access to education for students and adults, especially those who cannot attend schools, either because of their work or because they suffer from some other impediment. The convergence of the already existing home microtechnologies such as TV sets, videos, radios and telephones with the microcomputer will result in the latter being used as a means of communication. This will accelerate the need for the establishment of an open learning system in the form of an open university centred in Stockholm and with connected branches all over the country, particularly in those areas where students or adults might otherwise not have equal opportunities for education. This institution will heavily utilize the potential of microcomputers both as instructional and learning tools and transmitters of knowledge.

Also other types of nonformal education will be affected due to the increasing computerization process in almost all socio-economic sectors, providing a significant part of the educational activities traditionally pursued in formal institutions. Firms and other private organizations will provide training and retraining in their own educational departments and schools, particularly in those areas that are related to new information technologies. This training will be vocational, continuous and specialized, and employers will bear the cost of it. Thus the educational demands of the labour market will be primarily satisfied through the business world itself, and preferably in close co-operation with formal institutions. This development will have a positive impact in terms of the job-security of employees, while the needs of students will continue to be met by public institutions thus avoiding a regress to a free/paying educational system.

It becomes, therefore, apparent that (i) the traditional distinctions of the three modes of knowledge transmission will become less and less divergent, as a result of the introduction of computer technology in the school, the home and the workplace; and (ii) the concepts of distance, adult and special education will become more meaningful and relevant in terms of their aims and applications.

4.2. Pessimistic

From the pessimistic point of view, it is forecast that schools in wealthy or urban communities such as Stockholm, will proceed faster with computer implementation than others. Furthermore, students or families who are economically constrained or otherwise disadvantaged will be excluded from the potential benefits of new technologies. These trends will considerably exacerbate the inequality of educational opportunity and outcome as well as social inequality, in turn reversing existing policies towards a more egalitarian society. Finally, educational institutions, instead of being users of the computer's central service network, will become simply its satellites, losing their importance with consequent negative implications for students, parents, and the nation as a whole. This detrimental impact will be greatly accelerated by the gravitation of educational decision making from the field itself to network specialists and managers. In general education will be further commercialized and this will have negative implications for the democratic control of education and socio-economic equality.

4.3. The Most Probable

Until recently the central controversy surrounding computers in education in Sweden has concerned the very issue of their introduction in schools. Presently the debate centres on the procedure of introduction, the choice of technology to be introduced, and the programme of utilization once they have been introduced. In the future if computer capacity should approach or surpass that of the human mind, there will inevitably be new concern about the introduction of such advanced technologies to schools.

The computerization process in Swedisch schools will most probably progress rapidly, especially over the coming decade during which all schools from primary upwards will be adequately furnished with computer equipment. However, the benefits of this development will not be realised evenly across the country, as wealthy and urban areas will most probably be advantaged, in spite of political will to the contrary both at the local and national levels.

The most probable forecast regarding home-computerization is that development there will be faster than in schools due to the continuous decrease of hardware prices, increased capacity, and the improvement of the quality of software adapted to home microcomputers.

Formal education will not be able to respond to the emerging information society's increasing demand for knowledge, and the labour market's needs. Therefore, education will take on a nonformal character primarily associated with training and retraining within firms, but also concerned with such issues as distance and individualized education. The latter will be greatly facilitated by the convergence of the already existing homemicrotechnologies with microcomputers. The home and the workplace will thus become learning centres realizing many of the functions presently associated with the formal mode. One likely outcome is that courses in firms, which in the past were restricted to the satisfaction of immediate internal needs, will become increasingly formalised, covering a range from basic training up to university level, meeting the external demands of the labour market as well as their own. In this way education will be increasingly commercialized, especially in the area of new information technologies, and thus public institutions will suffer severe competition. Computer and consulting firms will cover a significant part of the labour market needs in basic vocational, continuous and specialized training in the field of microelectronics. Also, since the formal educational system could not possibly keep pace with the restructured needs of the labour market on its own, its development is likely to involve co-operation with the nonformal educational sector. Furthermore these developments will render meaningless the traditional distinction of the three modes of educational transmission.

5. The Impact of Computer Technology on Learning Processes.

Clearly, what the emerging information society demands is information, and computers are powerful processors of information, rapidly becoming smaller, cheaper, smarter and more functional. This development goes side by side with the development of an integrated information system, encompassing microcomputers and the other information microtechnologies, which in turn will open new possibilities for aiding human learning and so providing a further dimension both to distance and individualized instruction and learning.

There is a widespread notion that individualization of instruction has positive effects on learning and the computer is said to make it easier and more effective (Suppes, 1966). However, as far as the issue of individualization is concerned, there is much disagreement regarding whether the computer contributes to individualized teaching and also whether individualized teaching is socially desirable. Bates and Pugh (1975), Rowntree (1976), and Willén (1981) conclude that instructional technologies including computers cannot meet the individualization needs of teaching. This is largely due to the unique role of the teacher both in creating a tutorial programme and in understanding the pupil's needs. Eide (1981) points out that the role of some educational technology, such as the computer, in individualized teaching is merely a fantasy. He writes that: "individualized teaching should provide every individual with exactly what he or she needs. But this again presupposes a common agreement on what individual needs are... Furthermore, the more extreme ideas about individualized teaching neglect the fact that, to a very extent, education is a social phenomenon. The social setting cannot in most cases be differentiated according to individual preferences" (p.102).

Baker (1974) also states that "the pupil is responding rather than initiating, reacting rather than inaugurating. The pupil becomes dependent on the programme, being programmemed by the microcomputer, rather than developing multi-experiental routes" (p.114). It is true that the ease, effectiveness, reliabililty, and speed that the microcomputer offers to the pupil, may significantly affect other valuable school and social activities, group work and participatory learning as well as to indulge the natural human inclination to take the very easy way, so turning one's education into a lonely, stereotyped and mechanical process. These warnings provide wellfounded reasons for many educationists and other social scientists to remain sceptical about the introduction of computers as means of instruction. Botkin (1982) identifies at least three ways in which the use of computers inhibits group interaction: (i) "...from an overemphasis on individualization; (ii) from the tendency to concentrate large computers in centralized dataprocessing centres; (iii) from the specialization and complexity of computer software which often obscures the assumptions and freezes the values built into the programmes" (p.23). One fact that should be of special concern to every citizen is that the centralization and control of educational software given through computer assisted instruction provides new possibilities for more effective methods of brainwashing that might be used by a totalitarian and undemocratic regime. A crucial question that could be raised, therefore, is how the computer could overcome these shortcomings and dangers and be used both in more creative ways and as a tool for democratic control. There are three issues concerned with this question. First is the idea of using the computer for "learning with" it rather than "learning from" it. This notion is closely related to Papert's (1980) thinking that instead of the teacher's beneficial use of the computer to programme the pupil, the pupil should rather be instructed to programme the computer, and in so doing stimulate his analytical thinking and creativity. Second, to equip every citizen and every teacher regardless of his/her main area of specialization with adequate knowledge about computers. The latter should be able to create their own software adapted to the needs of their pupils. Third, the development of a new area of study within teacher education which will mainly deal with educational software development. Undoubtedly, educational microcomputer technologies bring some dangers to the learning process itself. However, they do play a constructive role in education and can be used effectively to facilitate learning and teaching; but "teaching" is really an art in which the human dimension plays so unique a role that it cannot be assumed or changed by any form of technology.

6. Three Alterrnative Scenarios of the Impact of computer Technology on Learning Processes.

6.1. Optimistic

In the past one of the main factors inhibiting the introduction of computers in schools was the failure of educators to evaluate them as pedagogical tools. Today, educators' attitudes are changing due to the increasing development of computers into more sophisticated and useful tools, capable of helping the process of learning considerably. Though not hitherto realized, the potential of computers to function in the learning process will be harnessed over the next two decades, greatly expanding their role and contribution to education.

However, as is known, the most important part of the computer system is its software, that is, the instruction given to it to perform a certain function, and not its physical part itself, the hardware. From the pedagogical point of view, it is optimistically forecasted that educational software will be developed in close co-operation between expert programmers, computer analysts, educators and others. On the technical side, this development will be associated with the further standardization of software, which in turn will enable the user to avail himself of a great quantity of software regardless of the trademark of his hardware. In addition, an advance of considerable importance will be the development of high-level and user-friendly computer languages which will enable pupils to create their own programmes using computers as tools for "learning with" rather than "learning from". In this way too, teachers will be able to produce their own software to meet the needs of their pupils and to utilize the potential benefits of foreign educational software, adapting it to their own social and educational context.

The pupil will actively participate in the use of the computer as a tool for problem-solving educational activities, increasing his

motivation and stimulating his personal initiative and creativity. This will expand learning opportunities and facilitate the use of the computer at all school levels and especially in distance and individualized learning.
The computer will not only be used as a tool for learning and instruction, it will also contribute to the process of learning through other applications in areas such as drill and practice administration and as an organizational and planning tool. On a higher level it will have an evaluative function assisting decision-makers and educators. Optimally, any particular instructional or learning application of the computer will only be accepted along with the theory of learning behind it.

6.2. Pessimistic

With regard to the pessimistic scenario, it is forecast that the wide and uncritical introduction of computer assisted instruction (CAI) in Swedish schools over the coming two decades and educational managers' overemphasis on computers' potential benefits as instructional, learning, organisational and planning tools will bring about some considerable negative changes at many levels.

The wide adoption of CAI or mechanically programmemed instruction will reduce the need for having both schools and teachers, since many courses could be given through suitable terminals linked to the teaching computer. There is no need, therefore, for a student to participate in a course given in a particular classroom. If education is taken over by machines the number of teachers employed will be considerable reduced, and the role of those remaining will become primarily monotorial, supervisory and administrative. In this way also the advantages of participatory learning from the social and pedagogic points of view will be greatly affected and the process of learning will become lonely, stereotyped and mechanical.This last tendency will be reinforced in a situation where the computer will be heavily used as an instructional tool, with students rather "learning from" than "learning with" the computer.

A rapid introduction of computers for instruction and learning as well as for organization and planning without the development of the appropriate infrastructure, along with an experimentation phase,will negatively influence the organization of educational activities, straining existing educational structures and detracting from the more positive aspects of the process of computerization in schools.

One issue that should be of special concern with respect to the pessimistic scenario is that centralized control of the content and method of instruction through computers will generate new possibilities for more effective brainwashing, providing a powerful instrument for a totalitarian and undemocratic regime. Finally, if educators adopt educational software uncritically, be it locally produced or foreign, computers will become a new medium of cultural imperialism, especially in non-western countries.

6.3. The Most Probable

The first point to consider in this scenario is whether the impact of computers on the learning processes is likely to have a dramatic effect in the Swedish context. We can probably expect that the use of computers will extend significantly beyond their mere use for instruction about the technology itself, and even beyond the range of the natural sciences. Though the computer will be used as an instructional and learning tool, this does not have major negative implications for the role of the teachers or their number. In fact, it seems probable that their role will be improved and their number increased.
Computers will become pupils' and adults' friendly partners due to the development of high-level easily learned computer languages and this will considerably facilitate their use in both distance and individualized learning. Though some subjects will be better suited than others to the computers' instructional applications, this process is unlikely to become overly dominant. Some courses will be realized almost exclusively through CAI but in compensation other new courses such as "futures" will be introduced, helping pupils and students to cope with the needs of the new information society and a rapidly changing world. The use of computers, in general, will increase the pupils' understanding and stimulate analytical thinking and creativity.

Foreign educational software will have a great share in the Swedish market, especially in the area of the sciences and languages, but this is not likely to have a major cultural impact due to the relatively narrow gap between Sweden and the principal source-countries. Most of the educational software will be centrally produced by software houses, teachers and pupils then taking on the role of consumers. Because of the high level of the democratization process in Sweden, people's increased critical awareness, general caution regarding experimentation and the social intervention of unions, computers will never be used for undemocratic purposes, nor will they displace teachers. They will simply be used as tools complementary to the traditional methods of knowledge transmission, namely, lectures and seminars.

7. The Impact of Computer Technology on Computer Literacy

There is a widespread warning that educationists in the near future will be challenged by a new kind of illiteracy-computer illiteracy. Computer literacy then is rapidly becoming an essential part of contemporary education. The most recent role for computer assisted aids in education is in the area of "computer awareness" and "computer literacy". These two concepts have been very much debated in recent years and they have often been ill-defined (Johnson, et al., 1980, Luehrmann, 1981, Anderson, et al 1981, Terry, 1984). It may be said that "computer awareness" involves becoming aware the existence of computer technology, its historical evolution, function and possible socio-cultural implications. On the other hand, "computer literacy" includes whatever "computer awareness" involves and in addition, ability and skill in computer programing. Bohland and Anderson (1978) identify two types of computer literacy: first, "general computer literacy"; and second, "functional computer literacy". The former deals with providing a general knowledge about computers and the latter with providing specific computer education in a specific working environment.

Sweden has already entered the new information society and it is likely that almost all jobs within the coming decade will be extensively computerised. This implies that those people who do not know how to use computers will not only be at a disadvantage but they will also bring considerable obstacles to the computerization process with consequent negative implications to the national development. It is found that more than 30 per cent of the computer equipment in Sweden is underutilised or not used at all due to the lack of appropriate knowledge (Makrakis, 1985).

The computerisation process in Swedish schools has also been affected by the inefficiency of the teaching community to meet the new demands, and utilize, to a full extent, the already existing computer equipment, due again to the lack of computer literacy. A recent survey carried out by the National Board of Education revealed that, though computer education has been introduced as a compulsory subject in all schools across the country, one third of them had no activity at all in this field, and that only about 1.400 qualified teachers are involved in computer education, that is .95 teachers on average per school (Myrberg, 1984). Simultaneously, there are more than 35.000 teachers in lower secondary schools who need both basic and further computer education, and this need can be satisfied to only 5.000 out of them yearly. Taking into account this fact along with current policies concerning the introduction of computers in schools and other optimistic projections that microcomputers will be placed on every pupil's desk and become just another school-tool of the same type as rulers and calculators, how can progress be made then if a great number of teachers have no or little commitment to computers at the conceptual or practical level? This lack of background and training of teachers, as Telem (1984) states "might deter the proper and effective use of the computer as a support tool for administration and instruction and even cause the failure of the computerisation process in the schools" (p.23). He suggests that a way to overcome this situation effectively and rapidly is the establishment of a comprehensive training programme which will prepare educational personnel in the new technology. Terry (1984) emphasizes the need for in-service training of teachers at all levels and in all areas for the use of the computer in school with their own pupils and for their particular subjects. He maintains that there is no need for the majority of teachers to become expert programmemers, but the latter have to work in close consultation with classroom teachers. It is clear that if teachers do not succeed in becoming computer literate, then the status and the prestige of the teaching profession will be seriously threatened. If the promise of the computer is not to be turned into a threat, as Donhardt (1984) states "educators must maintain a healthy perspective of how microcomputer technology will be used to accomplish pedagogical goals" (p.30). He stresses the need to build computer-based curricula which will place technology in a supportive facilitating role. According to him, a computer-based curriculum must accomplish three things as a minimum: "(i) it must have sound educational objectives; (ii) it must reflect an awareness of how students will learn from an interaction with the computer; and (iii) its objectives and their tests must be measurable" (p.30). Clearly, before computers can make an organized impact on the nature of classroom activities, teachers' education must accomplish three major tasks: first, a considerable amount of training has to be invested both in general computer literacy programmemes including all categories of teachers and in specialized computer training in such areas as programming, curriculum development and development of software; second, re-organisation of traditional models of initial and in- service education; and third, an orientation to the needs of tomorrow's learners. The third factor reinforces the need for "futures" studies in the field of education.

8 Three Alternative Future Scenarios of the Impact of Computer Technology on Computer Literacy

8.1. Optimistic.

Optimistically, it is forecast that all Swedish pupils, regardless of their area of study, will have an adequate level of general computer literacy by the end of the coming decade, at latest. Over this period the teaching community will also be well prepared to meet successfully pupils' current and future needs in the area of new information technologies.

The present difficulty in implementing computer literacy programmes in Swedish schools, due to the lack of appropriately qualified teachers, will be overcome through the integration of computer education in teachers' basic and in-service training at all levels and in all areas. This implies that all categories of teachers will acquire a thorough general knowledge about computers, and those teachers who are concerned with computer education itself will achieve and maintain a competent level of computer knowledge through further education and recurrent training. The number of these specialised teachers in each school will be proportionate to the number of pupils and they will be responsible for the implementation of computer literacy programmes, co-ordinating the use of computers in other areas as well. The high level of computer literacy that is optimistically forecast for all teachers will provide them with an invaluable tool for choosing and assessing educational software as well as for adapting it to their teaching. Optimally, a minimum level of computer knowledge will also be introduced for young pupils as early as possible, preferably from the first grades of compulsory schooling. This will prepare the children for later computer literacy programmes, other uses of computers and advanced programmes in computer technology.

Since new information technologies are agents of economic development and social change, the educational system, both formal and nonformal, will be developed towards providing all citizens with a general knowledge about computers, assuring them continued influence and adaptibility.

8.2. Pessimistic.

With regard to the pessimistic scenario, it is forecast that computer literacy programmes will not be implemented considerably in schools across the country due to the unequal competence of teachers in the area of computer education. A computer knowledge elite will thus be created, both among students and teachers, having a general effect on the equality of opportunity and outcome. As a result this will lead to a situation where the new information technologies will be in the hands of a select group of specialists, so reducing people's possibilities for influencing technological development in a human direction.

8.3. The Most Probable

It is likely, in fact, that the expectations outlined in the optimistic scenario will be realised for the most part over the next two decades. This is because there is a general consensus of opinion that this is the path that should be followed to cope with the demands of the new information society. It is clear, therefore, that all citizens will acquire a certain level of computer literacy above the international level.

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L'IMPACT TECHNOLOGIQUE DE L'ENSEIGNEMENT SUPERIEUR A DISTANCE DANS UNE PERSPECTIVE MONDIALE COMPAREE.

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1. Caractérisation des enseignements présentiel et à distance.

Traditionnellement on a opposé l'enseignement présentiel et l'enseignement à distance. Le premier est celui qu'on réalise dans la classe, par le professeur qui programme les activités, offre les stimulations et matériels et établit une relation directe face à face, par laquelle il peut adapter ses enseignements à la situation concrète du groupe et le cas échéant à chacun des élèves. L'enseignement à distance est celui qu'on réalise en absence de l'enseignant, hors de la salle.

Pourtant cette distinction qui nous oriente en principe, ne permet pas de comprendre le phénomène qui nous intéresse d'analyser, celui de l'enseignement à distance au niveau supérieur.

En fait, tous les moments de l'apprentissage où l'élève affronte le matériel didactique sans l'aide du professeur, sont fondamentals à tout système présentiel. Encore, quand on a voulu que l'enseignement ait un accent personnel on programme les activités et on offre les matériels de sorte que chacun suive son rythme individuel sans besoin de l'explication de l'enseignant. La présence de celui-ci, surveillante, stimulante et contrôleuse est moins nécessaire.

Un autre trait qui caractérise d'habitude l'enseignement désigné traditionnel d'une façon générique, est que les messages, les informations sont présentés par le professeur. L'axe de l'enseignement est situé à l'explication magistrale. Mais ce trait ne caractérise plus l'enseignement présentiel par rapport à l'enseignement à distance. Chaque jour on prétend de plus en plus que le centre enseignant soit - une source de stimulations didactiques, où le matériel de tout type devient un substitut de la tâche informatrice du professeur. Celui-ci stimule l'élève pour qu'il lise en profondeur les messages, interprète les langages "verbeconiques" présentés à la classe et même pour qu'il comprenne directement la réalité naturelle et socioculturelle environnante.

A l'enseignement à distance l'action du professeur est suppléée par les matériels didactiques, cette tendance-ci est croissante

aussi à l'enseignement présentiel.
Il ne s'agit donc pas de traits que les deux modèles d'enseignement puissent facilement confronter, sinon plutôt, il s'agit de pôles d'une ligne continue où chacun de ces deux systèmes s'approche plus ou moins aux extrêmes de cette ligne-là.
Peut-être, en cette position, dans le continu, où on ne trouve pas de sauts brusques ni césures absolues, le terme qui nous permettra de caractériser mieux l'enseignement à distance est qu'il s'agit d'un système multimedia. Bien sûr l'enseignement présentiel en est aussi et d'une façon progressive, mais il s'agit d'un trait qui est absolument indispensable aux enseignements à distance. Celui-ci, à cause de l'absence du professeur, de sa stimulation tout à fait estimable, doit lui suppléer en se pourvoyant d'une technologie qu'aux enseignements présentiels n'est pas si nécessaire.

2. Les enseignements universitaires à distance.

Bornons notre travail à l'enseignement supérieur et en particulier à l'universitaire à distance, puisque c'est un phénomène si récent qui bien mérite une analyse spéciale, en profondeur.
Il y a deux types fondamentaux d'enseignement universitaire à distance. Le plus fréquent on peut le trouver dans ces universités qui ont une partie de leurs élèves hors du campus, éloignés des classes et qu'il faut leur prêter attention avec des méthodes différentes de la traditionnelle classe et contrôle de l'enseignant. Autrement, il y a un groupe moins nombreux d'universités qui n'ont pas d'élèves présentiels. Toutes leurs ressources sont dirigées à prêter attention à une population au delà de leur espace physique, extra-muros sans le contact direct entre les enseignants et les enseignés. Ce type d'enseignement, usuel en autres niveaux, a commencé sous cette modalité au domaine universitaire, pratiquement la décade passée. L'exemple le plus brillant et qui a eu le plus d'impact au niveau mondial est l'Open University britannique. En 1971 elle inscrivait ses premiers élèves, encore qu'elle avait été créée déjà officiellement deux ans avant par le gouvernement britannique. Cet espace entre la fondation et la mise en marche est un phénomène généralisé. Aux enseignements présentiels il est décisif de compter avec les enseignants, les classes, les laboratoires ou les bibliothèques et de commencer immédiatement. L'explication du professeur et les matériels qu'il offre, on peut les improviser ou sélectionner selon l'exige la ligne de sa programmation et la situation concrète des élèves. Par contre à l'enseignement à distance il faut une période pour une élaboration soigneuse de matériels. Les deux ans de l'Open University (1969-1971) sont une mesure assez généralisée.

Des universités à distance on donne les deux dates, quand on dispose d'elles, ainsi que le nombre approximatif de leurs élèves et les moyens technologiques les plus employés.

3. Ressources technologiques employées.

Chaque université emploie d'habitude un système différent conformément à leur disposition des ressources.

3.1. Le matériel imprimé.

La première ressource, la plus utilisée et en fait la principale responsable de l'apprentissage de l'élève, c'est le matériel imprimé. Les textes que l'élève reçoit chez lui ont presque toute l'information qu'il doit connaître et assimiler et ces textes-là sont le substitut plus direct des activités du professeur. Cela a conduit à quelques-uns à qualifier cet enseignement universitaire à distance comme enseignement par correspondance, donc, la façon la plus traditionnelle de relation enseigné-enseignant était l'envoi de matériel par courrier.
Au cas limite ce matériel reste le manuel classique universitaire accompagné de livres de consultation - toujours si peu - au moins les obligatoires, supposé que l'éloignement du campus universitaire ne permet pas de recourir à la bibliothèque, comme il arrive aux enseignements présentiels.
D'habitude les livres de texte sont accompagnés des "Guides Didactiques" lesquels suppléent les tâches que le professeur développe dans la classe. Surtout on développe la motivation, le contrôl et l'évaluation. Ces Guides Didactiques sont parfois compris dans le même texte ou bien edités séparément, mais de toute façon ceux-ci se révèlent indispensables pour l'étude personelle, indépendante. Les Guides fréquemment incluent des résumés où l'élève trouve articulé et systematisé ce qu'il y a de fondamental dans l'information, des conseils pour l'étude en indiquant thème par thème les sources concrètes ou des activités par lesquelles l'élève applique les connaissances et pour qu'il acquière les habilités necessaires. Peut-être les exercices d'auto-évaluation en sont les plus intéressants puisque on doit y trouver presque la totalité de la matière objet d'évaluation et en même temps cela permet que l'enseigné essaie les modalités d'examen pour éviter le dérangement de celui qui s'est preparé en pratiquant des activités mentales très différentes de celles qu'on exige aux examens. Avec periodicité on envoie à l'élève de petits cahiers d'évaluation à distance. A l'UNED espagnole il y en a quatre le long de l'année scolaire, dont le premier objectif est que l'élève s'autoévalue et connaisse son niveau éxact d'apprentissage;

encore, cela lui permet de s'entraîner aux modalités des examens: des épreuves objectives, des épreuves d'essai, des commentaires de textes, la solution de supposés pratiques, etc. D'une manière complémentaire, ces exercices d'évaluation à distance règlent le rythme de travail de l'élève et ils permettent au professeur de connaître ses progrès, de trouver les manquements et de recommander les lignes opportunes de travail. Le problème à l'instant en tenir compte à l'évaluation finale est qu'on ne peut pas savoir s'il s'agit d'une simple copie, et non plus qui est l'auteur de travail.

De guides, des circulaires et des lettres en réponse aux consultations complètent ce matériel "verbeconique" qui permet d'étudier à l'élève par lui-même et qui doit être réalisé en suivant les principes de la technologie didactique. Cela est le premier objectif et le point capital. L'expérience révèle que les matériels offerts normalement ont un niveau scientifique acceptable, quelquefois excellent, mais leurs conditions didactiques laissent beaucoup à désirer. Les élèves exposent d'une façon réitérative dans les enquêtes que le vocabulaire est trop abstrait, technique, peu usuel et difficile. On prête plus d'attentoin au niveau et à la systématisation scientifique qu'à l'adaptation aux conditions de l'élève. On dirait qu'on est plus attentif au jugement des spécialistes du domaine et des collègues professionnels qu'à l'accomplissement de la fonction des textes, celle de servir vraiment pour l'apprentissage autonome.

La difficulté de ces textes-ci est le principal reproche qu'on les formule. Ils sont plutôt une manière de réitérer les manuels classiques qu'un instrument didactique pensé pour nouvelles situations d'apprentissage. Les graphiques, les vocabulaires des termes clé, les exercices appropriés et les exemples sont demandés unanimement.

Les principes classiques qu'inspirent l'éducation contemporaine tels comme celui de l'intuition et de l'activité sont réclamés constamment.

L'idéal est que les textes s'inspirent aux techniques de l'enseignement programmé, pour ainsi assurer le succès de l'apprentissage. La microdivision de la matière, l'autoévaluation permanente, la possibilité de suivre le rythme et encore jusqu'à la séquence la plus adéquate pour chacun sont des exigences aussi nécessaires que fréquemment pas accomplies.

Dans ces textes on trouve quelque chose qui arrive d'une façon similaire à l'enseignement présentiel. Les professeurs esquissent leurs enseignements avec peu de coordination. Les répétitions, les creux, les sauts au vide et les séquences mutilées sont le fruit d'un travail qui devait être interdisciplinaire et que généralement ne l'est pas.

Autre problème grave du matériel est qu'on le lance fréquemment sans contraster le temps necessaire pour l'assimiler. Il n'est pas bisarre qu'on exige une heure par jour pour chaque matière, comme dans le cas de l'UNED espagnole. Cependant cette exigence formulée dans quelques documents et même constatée par le temps dont l'élève dispose, selon quelques recherches, n'est pas tenu compte sur l'heure de rédiger le matériel didactique. Le professeur a toujours la sensation de mutiler en excès une information riche et vaste, et il veut renfermer dans les unités didactiques le maximum possible. L'élève, qui dispose d'un temps limité, se trouve des exigences qui normalement sont supérieures à celles des enseignements présentiels, où l'enseignant sélectionne et adapte les contenus d'accord aux possibilités de celui-là, et parfois a ses pressions qui demandent d'habitude que tout ce que le professeur n'a pas pu expliquer ne soit pas motif d'examen, malgré qu'on rejette unanimement la leçon magistrale comme la principale source d'information.

3.2. La radio.

Elle est le moyen technologique employé par toutes les universités à distance, et celui qui suit en importance le matériel imprimé. Pourtant, ce moyen trouve une difficulté fondamentale. Supposée la dispersion des élèves et leur horaire hétérogène parce que normalement ils sont déjà engagés avec des activités professionnelles et familiales, il devient presque impossible que la majorité suive les émissions. Les investigations offrent des résultats très variés, mais quand l'audience arrive à la moitié des inscrits on estime que c'est un succès.

Ses usages sont variés. La répétition d'une leçon écrite n'a pas de sens. Parfois on l'emploie pour motiver ou informer. Par exemple au commencement de l'année scolaire, à l'objet d'arriver au grand public.

D'autre part on l'emploie aussi pour discuter de thèmes d'actualité. Les cadres d'experts satisfont bien cet objectif.

Parfois on l'utilise aussi, pour apporter un thème d'actualité qui ne paraît pas aux thèmes rédigés logiquement temps avant.

A l'UNED les émissions qui se dédient à orienter l'élève avant de réaliser les épreuves présentielles ou celles destinées à expliquer les résultats, les réussites et les erreures sont celles qui réussissent le plus.

Il y a une lutte constante entre les professeurs et les techniciens et spécialistes du "moyen". Ceux-ci ont comme idéal la radio commerciale qui doit gagner de l'audience à tout prix, alors que les professeurs s'intéressent plutôt pour la densité d'information et l'impact didactique. Les formules pour conjuguer ces divers cas sont variées. En cas extrême les professeurs se limitent à présenter le contenu que des techniciens du son, speakers, etc.

réélaborent et lui donnent la forme appropriée, généralement dialoguée et même dramatique, c'est à dire, des mises en scène. A l'autre côté sont les professeurs qui lisent leur écrit, similaire à une leçon du texte. Une des émissions qui ont un grand succès c'est la dédiée à résoudre les cas concrets au domaine juridique. En tout cas la conjonction des professeurs et spécialistes de la radio admet diverses solutions et correspond plus à l'organisation institutionnelle qu'aux études sur leur effet à l'apprentissage.
Le point le plus important est qu'il n'y a pas moyen de déclarer obligatoires ces émissions, car il est impossible de trouver un horaire qui serve à tout le monde. Les heures avant de commencer le travail, matinales, et encore mieux celles de l'après-midi et même les nocturnes après la journée, sont les plus utilisées, spécialement ces dernières. A l'UNED il y a deux heures et demie d'émission de lundi à vendredi de 20 à 22'30 heures.

3.3. La télévision

Son emploi est plus limité que la radio pour la simple raison que ses coûts sont plus élevés. Pour l'élaboration des programmes, la diffusion, les récepteurs et les installations on peut calculer que les coûts sont à peu près vingt fois supérieur à la télévision. Il faut tenir compte avec un principe essentiel: l'emploi d'un moyen massif de communication a besoin d'un public également massif et cela se révèle plus difficile à mesure qu'on avance dans le système éducatif. Un programme de radio ou télévision dirigé à l'éducation primaire peut avoir un public composé de centaines de milliers, mais les chiffres se réduisent à l'enseignement moyen et en arrivant à l'éducation supérieure le public se réduit à un minimum non seulement parce que ceux qui étudient l'enseignement supérieur n'arrivent pas normalement à plus de 10 ou 20% de la population de l'âge correspondant, sinon surtout pour la quantité de matières auxquelles il faut faire attention et qui réduisent le public à des chiffres exiguës. On calcule que pour être rendable une émission de radio doit avoir 15 élèves et à la télévision 150.000.
En fait la télévision s'emploie d'une manière plus sporadique. Probablement l'exemple le plus brillant est celui de l'Open University mais à la plus grande partie des universités à distance son emploi est plutôt limité ou nul.

3.4. La cassette.

Ce moyen est le grand complément de la radio et celui qui permet de la libérer de la servitude du temps. Une fois enregistrée l'élève peut écouter l'émission au moment adéquat. Mais son utilité va au délà de la reproduction des émissions de radio. On a enregistré certaines leçons magistrales pour leur actualité ou bien pour l'intérêt de la personnalité de l'auteur, il est convenant d'employer ce moyen. On l'a utilisée aussi pour l'orientation personnelle, spécialement aux programmes de perfectionnement des enseignants. L'élève envoie une cassette au professeur avec les consultations, et celui-ci lui répond par le même moyen. La chaleur, la vivacité et le fait qu'il est mieux et moins difficile pour l'élève de parler que d'écrir donnent un valeur singuliére à ce type de consultations. Pour l'apprentissage des idiomes elle est devenue un instrument indispensable à l'enseignement présentiel, et à plus forte raison à l'enseignement à distance.

Pourtant son emploi est plus limité que la radio bien que son rythme de croissance soit plus grand.

3.5. La vidéocassette.

Son usage est en train de se généraliser mais on l'emploie plus pour des tâches de communication et divertissement, que pour l'information stricte.

Son manque limité, son emploi plus que les audiocassettes. On calcule qu'il faut cent heures de travail tout au moins en équipe pour produire une bonne vidéo pour une classe. Malgré le pouvoir de suggestion et de motiver qu'il possède, les niveaux d'information offerts sont inférieurs à ceux d'une leçon de texte écrit.

Il a aussi des usages qui difficilement peuvent être substitués par d'autres moyens, spécialement quand on veut ramasser des séquences impossibles d'enregistrer fidèlement dans le texte écrit. Il a l'énorme avantage de combiner le visuel et l'auditif, mais son coût est encore prohibitif et sa reproduction demande l'appareil de vidéo et la télévision, et bien que sa diffusion croisse très vite, il n'est pas encore sur le point d'atteindre tous les élèves. Tous les systèmes à distance l'emploient mais à présent il a une valeur incidente et parfois simplement testimoniale.

3.6. L'ordinateur.

Toutes les universités à distance en disposent. Son usage est introduit pour collaborer aux tâches administratives. Après, cet usage est devenu général pour l'investigation, et surtout pour en faire sur la même université à distance.

De toute façon il n'est pas fréquent de l'employer dans l'enseignement, malgré une tradition d'enseignement assisté par l'ordinateur qu'on l'utilise déjà il y a longtemps en tous les niveaux.

Les exemples les plus brillants de l'utilisation de l'ordinateur dans la programmation et déroulement des enseignements sont à la Feruniversität allemande et à la Téléuniversité de Quebec (Canada).

3.7. Le satellite.

Son usage est vraiment exceptionnel, supposé son coût élevé, seulement en figure à la Téléuniversité de Quebec. Les grandes distances de ce pays-ci y obligeaient. Aujourd'hui ils en ont deux: l'ANIK-C et l'ANIK-D.

3.8. La téléphone.

Malgré ses énormes possibilités parce qu'elle permet une communication instantanée, son usage est d'abord limité. Entre le 5 et le 10% des inscrits emploient la téléphone encore qu'elle est une voie indispensable pour rompre l'isolement, puisque cela c'est le talon d'Achille de l'enseignement à distance. On emploie divers procédés. Il est usuel de téléphoner directement, soit au Siège Central, soit au réseau de Centres d'Etudes ou Associés qu'en ont toutes les universités. Pour éviter le possible blocus où sont présents les professeurs et parce que le coût de l'appel dès longues distances normalement détourne beaucoup de monde pour employer ce moyen, il est fréquent d'enregistrer les messages. L'élève communique ses données personnelles, le motif de sa consultation et son numéro de téléphone. Le professeur lui téléphone. Ainsi, celui-ci distribue mieux son temps pour prêter attention à tout le monde en évitant que quelques-uns monopolisent le temps réduit qu'il possède et en plus on évite que tous les coûts soient supportés par l'élève. Une investigation réalisée à l'Uned espagnole a constaté que la moitié des appels était entre 5 et 7 minutes et que les élèves recourissaient à la téléphone spécialement les dates précédentes aux évaluations. Le premier motif était de recevoir des orientations pour réaliser mieux les examens.

4. Les investigations sur les Universités à distance.

Le problème fondamental que doit affronter l'Université à distance est l'emploi rationnel des technologies. Les analyses de coût-bénéfice sont indispensables.

L'enseignement présentiel a un caractère artisan. Le téléenseignement exige l'élaboration de produits technologiques dont la diffusion est théoriquement illimitée.

L'improvisation de la classe présentielle, tout au moins dans sa forme devant les élèves, dans le cas de l'enseignement à distance doit être substituée par une soigneuse préparation et évaluation des matériels.

L'idéal est que tous les matériels soient soumis à une évaluation formative, c'est à dire qu'avant de leur diffusion ils aient été soumis à une investigation soigneuse, en étudiant leur impact sur une partie du public potentiel. Mais cela n'est pas fréquent. D'habitude on élabore les matériels et après les réactions des professeurs et élèves permettent de les dépurer.

Les procédés pour réaliser cette évaluation additive sont multiples. On essaie le matériel en groupes réduits. On recourt aux questionnaires et entre eux pour ramasser les avis de professeurs et élèves. En autres occasions, on envoie le matériel à une partie de la population qui le recevra pour ramasser leurs avis. De toute façon, il n'est pas facile d'établir une évaluation objective. Elèves, professeurs et spécialistes dans la matière ont normalement des opinions différentes. Quant aux premiers l'important c'est la clarté, la facilité, et quant aux seconds la rigueur scientifique et la densité informative.

Le problème fondamental est l'utilisation appropriée de chaque moyen au moment et mode opportun pour former vraiment un système multimedia.

Il faut compter avec un public dispersé qui se trouve en contact avec les niveaux, intérêts et situations d'apprentissage très variées. Il y a autant de variables et le système d'universités à distance est si récent que la conclusion la plus générale à travers les investigations réalisées est qu'on doit continuer ainsi.

Pourtant il y a aussi une remarque généralisée: on infrautilise la technologie disponible à l'application à l'enseignement et concrètement à l'enseignement supérieur.

Auprès de cette sous-dotation de moyens technologiques et d'appareils destinés à l'enseignement (Hardware). Il y a encore un manque majeur de programmes spécifiques qui fissent rentable l'acquisition de ces matériels. Les programmes, les matériels de pass (Software) sont absolument insuffisants. Il faut des équipes de spécialistes pour élaborer un matériel coûteux et qui malheureusement sera vieilli bientôt. Pourtant ici on doit remarquer qu'il y a beaucoup de possibilités qui n'ont pas été bien exploitées. Chaque université essaie de réaliser toute seule cette tâche de l'élaboration des matériels. Il y a des travaux intéressants pour conjuguer les efforts de diverses institutions, mais la coordination est insuffisante et à cause de ça les coûts se multiplient, on ignore des matériels d'un niveau exceptionnel et un projet quelconque deviendra trop cher. On demande constamment la coordination au niveau national et même international mais encore aujourd'hui les rendements sont limités. Pourtant, on ne peut pas se passer de faire une remarque sur quelques exemples intéressants. En Colombie toutes les institutions officielles et non officielles d'éducation postsecondaire à distance restent coordonnées au niveau de planification et évaluation par le Ministère d'Education (ICFES. Programme National d'Université Ouverte et à Distance) au niveau politique et consultatif par le Conseil National d'Education Ouverte et à Distance, et pour la coordination générale par la Présidence de la République. L'Allemagne Orientale, à 1969 a établi au Ministère d'Education Supérieure, un organisme pour coordonner les programmes d'éducation à distance offerts dans 20 de ses 54 universités. Un autre modèle différent est l'Université de Mid-Amérique (UMA) puisqu'elle n'est pas de l'Etat, celle-ci coordonne les programmes à distance de 7 universités. En Autriche à 1981 on a fondé l'Institut pour l'Education à Distance, dont le siège central se trouve à l'Université de Klagenfurt qui coordonne et évalue les programmes de 8 universités.

D'une part il est convenant de fuire une uniformité périlleuse qui deviendrait un impérialisme culturel, mais d'autre part on doit éviter l'attitude de l'Adam de vouloir commencer tout "ab ovo".

Malgré ces déficiences il faut reconnaître que les universités à distance sont en train de réaliser un effort plus grand que les universités présentielles sur l'heure de recueillir les innovations, les employer et les évaluer.

Depuis toujours on a valorisé comme un paradigme les enseignements présentiels. Chez les enseignements à distance on les considérait comme une seconde catégorie pour manquer la présence physique du professeur, celle-ci a été toujours vue comme la clef du système d'enseignement. Pourtant en une ère technologique où les messages et les meilleures expériences peuvent être enregistrés, dépurés et présentés en excellentes conditions, il s'impose une remodulation de l'enseignement et du rôle de l'enseignant de l'angle de la technologie. L'art du professeur devient technique dans le matériel éducatif. Aussi l'action ponctuelle du maître se troque en une diffusion illimitée des matériels didactiques. L'évaluation de l'action du professeur, toujours difficile par son caractère éphémère, au cas du matériel technologique est une nécessité non facile d'esquiver. A cause de ça toutes les universités à distance ont monté des équipes chargées de l'évaluation du propre système. Cela est le cas de l'Institut de Sciences de l'Ecuation de l'UNED espagnole; l'Institut de Technologie Educative de l'Open University britannique ou le Zentrales Institut für Fernstudienforschung (Insitut Central pour l'investigation des études à distance) à La Fern Universität allemande, à Hagen.

De ces évaluations, il faut remarquer que l'immense majorité a un caractère descriptif et elles recourent au questionnaire comme la voie fondamentale.

Les études empiriques rigoureuses sont insuffisantes et encore plus les expérimentales. Les évaluations formatives sont insuffisantes comme on dit déjà. Il est plus fréquent de rencontrer celles de caractère additif, c'est à dire celles qui étudient les produits déjà conclus.

Théoriquement, avant d'instaurer n'importe quel système à distance, on a réalisé une évaluation du contexte où on prétend diagnostiquer les nécessités qui seront soignées par le système à distance et les possibilités et moyens dont on dispose pour y répondre. Bien que cette demande soit normalement accomplie, les conclusions influent peu au dessin des universités à distance, car elles répondent à d'autres objectifs de politique sociale, culturelle et éducative. Ce qu'il y a d'important c'est de configurer un système qui arrive aux populations marginées et dépourvues encore au présent pour ne pas pouvoir assister aux classes universitaires.

On remarque que le résultat de ces investigations doit servir de base pour les futures prises de décisions. Les autorités doivent connaître les résultats pour remoduler le système, réélaborer les matériels, procurer atteindre des collectifs manquants et en résumé, obtenir la meilleure rente éducative des ressources inverties. En général on calcule que les coûts par élève des enseignements à distance sont entre la moitié et la quatrième partie par rapport aux enseignements presentiels.

L'impact des évaluations est très réduit. Il y a encore beaucoup de facteurs et intérêts, qui décident de la configuration et les programmes des universités à distance. En tout cas, elle est évidente, leur expansion le long des dernières 15 années. Le nombre d'universités augmente tout comme l'inscription à chacune d'elles. Mais si on veut prêter attention à cette demande et la dilater à d'autres capes de la population, aujourd'hui éloignées psychologiquement et sociologiquement de l'université, il faut un emploi rationnel de la technologie et une rationalisation plus grande, ce qu'on pourra obtenir seulement si une investigation multimedia, comme l'est l'université à distance, permet de réorienter le système et amener au maximum ses réussites.

Pays-Université	Dates Fondation	Commencement	Elèves	Technologie des Communications
SUDAFRIQUE				
University of South Africa		1946	60.000	Audiocassette
CHINE				
Beijing (Collège TV)		1960		
Substitué par Université Centrale TV Chine		1977	500.000	Télévision

	Dates			
Pays-Université	Fondation	Commencement	Elèves	Technologie des Communications
URSS 14 Lycées Nationals d'Enseignement à Distance				
GRANDE-BRETAGNE Open University	1969	1971	160.000	Radio Audiocassette Télévision
USA Empire State College, New York		1971	5.000	Audiocassette
ESPAGNE Université Nationale d'Enseignement à Distance	1972	1973	100.000	Radio 12 heures par semaine
CANADA Athabasca University Téléuniversité (Quebec)	1972	1974	6.500 3.000	Téléconférence Télévision, Satellite et Ordinateur
ALLEMAGNE FEDERAL Fern Universität	1974	1975	24.000	Ordinateur
PAKISTAN Université Ouverte Ajiam Iqbal		1975	200.000	
VENEZUELA Université National Ouverte	1977	1978		TV 4 émissions de 25' par matière
COSTA RICA Université de l'Etat à Distance	1977	1978		

Pays-Université	Dates		Elèves	Technologie des Communications
	Fondation	Commencement		
ISRAEL Université pour tous	1973	1978	10.000	Radio Télévision Ordinateur
THAILANDIA Univ. Ab.Sokotai Thammafhirat	1978	1980	200.000	
JAPON Université de l'Aire	1981	1982	30.000	
HOLLANDE Université Ouverte	1981	1983		
INDE Andra Pradesh Univ.Ouverte	1982	1983	115.000	

THE ATHENE PROJECT OR INTRODUCING MICROCOMPUTERS IN SPANISH EDUCATION

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The name of the Greek goddess of wisdom has been chosen by the Spanish Ministry of Education and Science to label its pilot project intended to introduce microcomputers in Spanish education step by step. At the time of writing this project remains more or less unknown to the great majority of teachers and educators. Just a few journals have disseminated certain ideas concerning the guidelines of this project, but on the other hand no one knows how it will be possible to spend 500 million pesetas (US $ 2,7 million) in the present year when if public opinion has not yet received adequate information. And that in the same year when unemployment has risen to more than 21 per cent of the total active population.

Let us remember that, as it was pointed out some years ago, Spain is different. In other words, these facts cannot be surprising in a country like ours. Several reforms concerning university education, teacher's training, relations between State and private schools have been announced to the audience - i.e., university students and professors, teachers and so on - just a few days before their approval. (Note "few days", not weeks or months.) To some extent this procedure cannot be criticised and should be examined like a political device: a change for Spain, a change as rapid as possible. Nevertheless, undoubtfully, returning to our starting-point, more than a project, law or political device must be kept in mind when discussing, and deciding, the technological and educational future (and, to some extent, the economical future) of a country wishing to get out of a very critical situation.

In any case, however, the Athene Project is running. It is worth while revealing some of its top secrets at least.

General outline

During the next five years, including 1985, the Athene Project will be running in those provincias and autonomous territories where there is no full autonomy yet in terms of educational policy. The Project includes three main sections: school equipment with adequate hardware, software, and teacher training. In fact, it has begun in those schools previously selected as pilot centres for the secondary education reform. This reform project includes microcomputers at this level, but considered as a subject matter with optional status. Those autonomous territories, with previous relationships with the Ministry of Education and Science (MEC) in order to develop educational software and to train teachers, will be prioritary.

Total investments are as follows: 4,777 million pesetas, 67 per cent devoted to equipment; 19.6 per cent, training courses; 7 per cent, meetings; 6.7 per cent, general costs; and 3 per cent, educational material. During the following five years it is hoped to achieve the necessary material provision for 1,843 schools (1,155 in primary and lower secondary education, 414 in upper secondary education, and 274 in technical secondary education). This represents 9,215 microcomputers, 685 training courses for teachers - some 1,300 will be specialists and another 5,530 just general teachers -, and 34,844 seminaries and workshops.

But those persons involved in the final drafting of the Project feel that those investments are not enough, specially if compared with those devoted to the introduction of other technologies or with those necessary to maintain within reasonable limits the deficit of some public enterprises. They believe that, when evaluated after the first two years, more investments than initially designed will be needed in order to raise the number of schools equipped with microcomputers. It must be kept in mind that there are more than 14,000 primary and lower secondary schools in Spain now, so that the last school will receive its microcomputers in 1999 if investments are not increased.

On the other hand, five microcomputers per school does not seem an adequate ratio when considering the high pupils/classroom ratio existing in Spain. Presumably, ten or fifteen microcomputers per school could be a more effective ratio; yet it would represent of course two or three times the actual amount of investments.

Comparative Considerations

Supposedly, these new ratios will allow to introduce microcomputers in Spanish education in a European form. For example, in Britain there are microcomputers per school at secondary level and one at primary level. Another example: France also has a project for introducing 20,000 microcomputers per year in collèges, Lycées and schools. In 1988, as expected, there will be 100,000 microcomputers in schools, this is to say one per 50 pupils. Britain and France, the two countries selected as models by the Spanish MEC, also have a very good production of educational software, some 1,000 programmes every year. But, can we compare the British, French and Spanish experiments at this moment? Obviously not, because the Spanish experiment is an unexisting one. At the time of writing, nothing of practical value has been done in Spain in order to introduce microcomputers in education. As an example, it was expected that in November (1984) the MEC would have selected some twenty educational units for teaching sciences, but it has not done it yet.

In 1960 the first microcomputer arrived in a British school. In the following decade most teachers were concerned with CAI and the Technological Educational Council set out the National Development for Computer Assisted Learning Programme, intended for postgraduate students and following American methodology. But, like in America, the lack of effectiveness - big machines, high costs - led this programme to a downfall. The microcomputer revolution was more or less rapidly assumed by the British government: the Microelectronics in Education Programme was announced in 1980; its main purpose was to promote awareness of new technologies, both in education and society, and also to increase teaching effectiveness. Two governmental departments are concerned: the Department of Education and Science, and the Department of Trade and Industry - as it occurs in Spain. The former copes with the design and updating of the project, and the latter with school equipment. The MEP has five sections. The first one is related to the understanding of technology. Children need some expertise and knowledge about it. This section begins with nine or ten year old children, and initially has a theoretical character, supplemented with some practical possibilities. The second section deals with computer science, its material and logical aspects. In this respect, MEP has developed adequate resources to the children (hardware plus software), prepared tests, booklets, videotapes which illustrate and facilitate good understanding of computer procedures. The third section is devoted to Computer Assisted Learning, developing programmes for almost all ages and subject matters. This section has acquired an increasing importance. The MEP has given funds to a great number of centres producing software, and cooperated with industries to develop new educational materials. The fourth section, perhaps the most important one, has the responsibility for information and documentation. Applications such as word processors and other systems are also introduced in schools. Obviously, data formats vary depending on the pupil's age, e.g., children between four and five years old use information supporting images, but between nine and ten years old they can elaborate and process information. The last section is devoted to special education - a missing section in Spain at the moment -, looking for applications to difficult children.

But there are also problems in Britain. The most important one has been to organize the system in order to allow more than 400,000 teachers to update their knowledge and skills. An important role has been assigned to the 109 LEA, who have a certain autonomy in their relationships with the MEP Central Committee.

Ten years after the introduction of the first microcomputer in a British school, the National Ministry of Education of France set up an experience at the Lycées level. In those years, computers tended to mean a certain kind of centralism and social control; some of those problems have survived. Between 1970 and 1976, 58 Lycées received equipment, also a few hundred teachers were trained, most of them specialised in scientific subject matters. Meanwhile some criticism appeared: a new knowledge order? would it be necessay to change the educational system? what kind of shock does the microcomputer produces in pupils? Some educators compare microcomputers to audiovisual equipment: bound to fail. Then, in 1978, the microcomputer revolution required a solution. A new project was then designed: 10,000 microcomputers were assigned to Lycées, in a context of technological revolution with an appearance of autonomy and self-sufficiency. In 1983 this project is extended: 100,000 microcomputers, 100.000 trained teachers before 1988. Nevertheless, current surveys show some lack of adjustment, specially related to teacher training. Presumably, in Lycées there will be plenty of machines and nobody will know how to use them.

Problems in Spain

Several of the problems mentioned above now exist in Spain, at least in some minds. Of course, issues are not only focused on investments. In this connection, probably the main problem will be teacher training and it is reasonable to suppose that more than a 19.6 per cent of costs need to be devoted to this aspect. A recent Fundesco survey showed that in Spain more teachers than expected are absolutely convinced that microcomputers will substitute them in a near future; others compare microcomputers to encyclopaedias; some others finally believe that, if asked, a microcomputer must know teacher's and pupils' names. These cases, unfortunately more than expected, reveal how necessary it is to promote the adequate information of teachers, and then train them wherever possible. Risks of underutilisation of microcomputers, or misunderstanding its educational implications must not be forgotten.

Table I shows a chronological evolution of investments and actions to be for the period 1985-1989. As it can be seen, teacher training does not receive as much care as required by international standards. Generally, in other countries the amount of money invested in equipment is also the same in the case of teacher training. On the other hand, MEC authorities have said that pre-existent structures and schemes could reduce costs. But what kind of them do exist in Spain and not in Britain or France?

In fact, at least in an early stage, teacher training is conceived as a general understanding of some information concerning the basic use of microcomputers or, so to speak, the domestic use. There is a very simple reason: microcomputers will come to schools in a near future - some enterprises are waiting like the big bad wolf -, so it is absolutely necessary to prepare a minimum number of teachers rapidly to use them. Not very qualified teachers, of course, but at least, let us say, basic beginners. These trained teachers will be appointed as instructors, whose responsability will consist in training other teachers who will rapidly become instructors of other teachers. The same procedure was used in Britain, but it is necessary to consider differences in context between the two countries; traditionally, Britain has been, at least in the recent past, more open to technological changes.

So, it seems that the Athene Project takes a too optimistic view of the future. For the moment, most teachers refuse to accept computers, not as a new technology, but as a technology they must introduce to their pupils in their classrooms. No special actions have been foreseen for the rural areas. However, those teachers who supposedly have an atittude against this new technology and its implications in their classrooms know almost nothing about Athene, what kind of microcomputers will be used, who will teach training courses, nor even if they will receive a microcomputer the next month.

And it is not a strange thought. The MEC has not decided yet really nothing, except the general features of the system. But there is another question: software. There are hundreds of

Table I: Athene Project, a chronological evolution of investments and actions to be done. 1985-1989. Costs are expressed in million pesetas.

	1985	1986	1987	1988	1989	Total
Schools to be equiped	200	217	219	586	621	1.843
Equipments to be acquired	1.000	1.085	1.095	2.930	3.105	9.215
Cost	330	358	361	967	1.025	3.041
Training courses	90	93	96	200	206	685
Cost	96	111	123	281	324	935
Number of meetings	1.664	3.380	5.152	9.840	14808	34844
Cost	29	42	56	88	121	336
General Cost	39	40	40	105	102	322
Cost educational material	6	37	37	31	31	142
Teachers to be trained	601	651	657	1.785	1.863	5.530
Teachers to be specialized	280	280	280	224	224	1.288
Total cost per year	500	589	617	1.467	1.603	4.777

educational programmes on the market, but at the moment nobody in the Ministry knows how to assist teachers in their evaluation of materials: no special regulations have been announced or issued.

As it can be seen, there are a lot of problems concerning the Athene Project and, above all, timing. What has been done in 1985? What is wrong in the Athene Project?

Results of a lack of a definite policy

Last March the definitive project was finally published: the Athene Project. A proposal for a rational introduction of new information technologies in basic and secondary education. It is important to note that in a technical sense this project is well planned. Its main sections are as follows: objectives (basic computer information, computer user training, the computer as a pupil's tool, the computer as a teacher's tool), curricula changes, teacher training, educational logic, the computer as a school management tool, computer equipment, supplementary activities, organisation strategies, evaluation, etc. But in another sense this project seems to be a technocratic one, this is to say, a project conceived as a mere strategy to introduce, perhaps too rapidly, microcomputers in education. There has not been a previous study on the real implications of this technology in a Spanish context. So, in other words, it is intended to answer some practical or technical questions, but probably not the main ones: Why is it necessary to introduce microcomputers in Spanish education? Of course, assertions like "Computers have a huge impact on some basic aspects of our culture like language and communications", or "Computers will bring a greater protagonism to pupils in schools", or "Teacher's objective must be to use computers as a means for easier learning, so that the teacher can arrange his time in order to assist slower or difficult pupils" could be read in the final project. But, what about Spanish pupils? Spanish teachers? Spanish homes? Does an ideal Spain exist in MEC experts' minds? What is needed is a reflection the impact of new technologies in a Spanish context.
Perhaps it will be easier for readers to consider some questions stated in a Ladislav Cerych's Report on Computer Education in sic countries: policy problems and issues (1982). Most of them have been answered in the Athene Project, if not all. There are definitive policy choices as, for example, "Should computer education remain an optional subject?" or "How can nation-wide transferability of software be ensured?". Yet these questions, and almost all questions included in Cerych's Report, could be seen as related to a basic, technical level. It is assumed that there is a

previously existing contextual framework - a framework previously analyzed.

Obviously this is not the case. Between Cerych's questions and Athene's policy outlines an immense space is completely empty. What the Athene Project represents is not a definite policy but a series of technological choices which subsequently establish a vaporous policy. Presumably the main result of such a lack of (general) policy will lead to a complete failure. Clearly, today's six year old children will at least experience some microcomputer possibilities. Undoubtedly they will come to Spanish schools? But what about Spanish education system/society relationships? Will a new educational system emerge? Will the same educational system improve its status in Spain?

An impossible conclusion

The Spanish educational system is now faced with several problems. Some of them could be examined as a heritage of ancient ages, especially Franco's régime. But some others are as old as the Spanish educational system is. One of them is inadequacy of the link between life and school. Another one is teaching staff - perhaps the most crucial. There is no space to describe the Spanish teachers' situation with the necessary accuracy, nor the high schools dropout rate. Let us simply say that, as a matter of fact, the main actual challenge to Spanish education should be different from promoting a new generation of teachers and retraining the existing ones. Yet these are just the author's desires. In any case, what Spain needs is a complete reappraisal of its educational system. Perhaps in this reappraisal, when done, a great deal will be devoted to new technologies. At the moment, however, rapid issues are not true responses.

LES MATIERES TECHNIQUES DANS LES CURRICULA DE L'ENSEIGNEMENT SECONDAIRE

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1. Introduction

Un traitement nouveau et intéressant du problème de la présence de la technique dans les curricula de l'enseignement secondaire est d'analyser quels sont les vecteurs de matières/groupes qui nous semblent plus remarquables dans les curricula de quelques pays relevants et paradigmatiques.

Si on préfère, il s'agit d'offrir un sélectif "background" pour la prise de décisions. Le travail du professeur Garcia-Garrido "Les systèmes éducatifs d'aujourd'hui" nous a servi de document basique pour notre travail. Nous avons décidé de nous arrêter à l'étude de la configuration des curricula en remarquant, nous arrêtant plus particulièrement, l'incidence de la technique et en essayant de justifier son importance quand on analyse les différents contextes sociaux.

Tout système formel de l'éducation, tend à la configuration d'une sorte d'homme qu'on considère très précieux dans une société très concrète. C'est-à-dire il doit tendre à l'obtention d'un patron idéal socialement.

Détecter quels sont les vecteurs (matières ou groupes de) configuratifs de la structure curriculaire/technique de chacun des pays selectionnés peut nous emmener à connaître:

a) quel est le modèle social éducatif et politique qui est établi dans chacun des pays sélectionnés.
b) vérifier si les curricula fonctionnent comme variable dépendante ou indépendante de la structure socio-économique.

Le problème de la sélection des contenus qui forment les curricula a été étudié par les sociologues du curriculum, qui ont essayé de répondre à deux questions:

- Pourquoi de tous les contenus possibles, il y en a seulement quelques uns qui ont été choisis comme valables?

- Pourquoi on exclut quelques élèves de certaines branches de connaissances et on les intègre dans d'autres?

Il faut remarquer que le choix des contenus a autant d'importance qu'il va permettre que le curriculum scolaire soit le déterminant parce qu'il affecte les manières d'organisation et le processus d'enseignement/apprentissage. Contrôler l'individu et de cette manière de configurer d'une forme concrète c'est la fonction des systèmes éducatifs parce qu'ils reflètent les valeurs de la société.

Ce qu'on apprend, comment cela est appris et pourquoi on l'apprend est complètement lié au contexte socio-culturel et au moment historique où est produit (A. de la Orden, 1.984) parce que la culture des sociétés vient des connaissances accumulées qui sont transmises de génération en génération. La culture apparaît comme un vecteur différentiel inter-social.

D'ailleurs on pourrait se demander si les curricula sont capables de répondre aux besoins économiques technologiques et scientifiques qui sont demandés par les sociétés actuelles où s'ils sont de simples constructions basées sur une idéologie concrète et qui n'ont pas un exposé sociologique strict.

Les curricula scolaires ont de notre point de vue une incalculable importance et comme dit (MUSGRAVE 1.972) "Le curriculum est elevé analitiquement au centre du processus par lequel une société utilise ses existences de connaissance". Il faut dire aussi qu'elle les utilise pour intervenir les individus qui forment la société de n'importe quelle manière pour réussir à un modèle d'homme concret valable pour la situation sociale hic und nunc.

2. Pays choisis

a) La France doit être étudiée parce que c'est le modèle le plus évident du système éducatif centralisé qui existe dans tous les pays démocratiques, c'est pour ça que nous avons cru nécessaire de nous arrêter pour étudier sa configuration curriculaire.

b) A cause de sa longue tradition d'administration éducative régionalisée nous avons choisi l'Allemagne. Il faut remarquer que dans ce pays seulement quand Hitler a été au pouvoir est établi un contrôle fédéral du système éducatif et s'est créé le Reichminister d'éducation et confort des jeunes mais après la deuxième Guerre Mondiale le contrôle du système éducatif est pris de nouveau par les lander (Garcia-Garrido, 1.981) c'est pourquoi c'est un paradigme des systèmes éducatifs régionalisés avec des notes bien différenciées par rapport aux systèmes centralisés.

c) On a cru convenable joindre dans notre travail un pays de régime communiste parce que ces systèmes sont très centralisés et de cette manière on peut voir des renseignements très intéressants pour notre travail. Nous avons choisi La Russie parce que dans les derniers travaux que nous avons faits nous avons remarqué que c'est un pays dans le bloc communiste très agglutinant et pour ça il a une haute valeur absolue dans les groupes d'analyse.

D'ailleurs, comme dans ce group de pays l'objectif est d'"Inculquer une conception marxiste-leniniste du monde de la science et de la culture" il agit comme vecteur relevant quand on formule des patrons sociaux (Gomez-Ocana, 1.983) il nous semblait très intéressant de voir quelle était la configuration curriculaire qui mène ce groupe de pays à atteindre ce vecteur du patron.

d) Il ne faut pas trop de justification pour inclure dans notre travail l'Espagne, non pas seulement parce que c'est notre pays mais aussi parce que les dernières années son système éducatif a été susceptible de multiples changements, parce qu'elle fonctionnait comme un système centralisé et maintenant, à présent son fonctionnement s'adapte à un régime de régionalisation. D'ailleurs nous aimerions bien constater que l'Espagne, comme un pays qui va s'intégrer au Marché Commun s'est transmise dans sa structure curriculaire aux pays choisis qui forment déjà partie du Marché Commun.

e) Enfin nous avons choisi le Baccalauréat international parce que l'idée d'une habilitation à la fin des études secondaires qui est basée sur un plan d'études unifiées et qui fut acceptée internationalement nous semblait pouvoir nous emmener à donner une interprétation plus universelle du problème de l'enseignement secondaire en même temps que nous constations les coincidences curriculaires avec les autres du groupe et en plus nous aider à remarquer des caractéristiques relevantes du groupe d'analyse.

3. Traitement des renseignements

Pour le traitement des renseignements nous avons choisi des techniques de groupement à cause de la bonté pour les études, sociologiques, comparatives et systématiques aux sciences de l'Education.

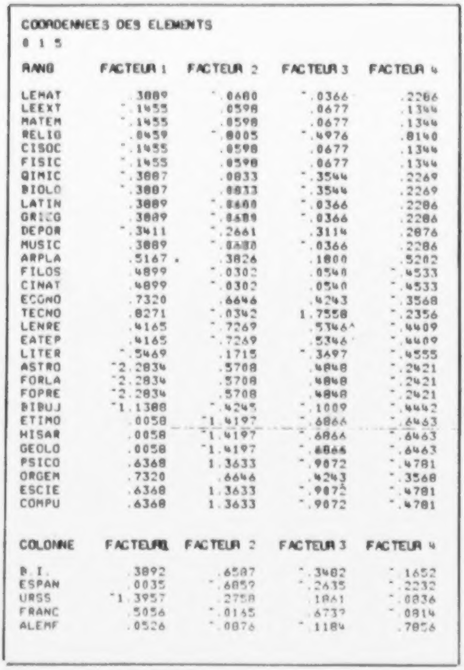
Tout investigateur doit essayer d'expliquer le phénomène observable avec le modèle le plus simple d'apprendre la réalité c'est-à-dire avec la théorie la plus élégante. Le modèle mathématique le plus simple pour décrire des variables aux termes des autres c'est le modèle linéaire. Nous nous trouvons ainsi, avec la pertinence pour notre cas et à un premier niveau d'analyse, de la technique factoriale dont l'objectif est de découvrir une variable en autres termes (facteurs sons jacents).

Dans un second niveau d'interprétation nous appliquons les techniques de "cluster" en choisissant le spécifique de cluster de groupes homogènes (On dit qu'un cluster est homogène quand il coincide avec son origine). C'est à dire, que tous les éléments qui forment un groupe se placent exactement sur un point.

B.I.	L'ESPAGNE	URSS	LA FRANCE	L'ALLEMAGNE	
X	X		X	X	LANGUE MATTERNELLE
X	X	X	X	X	LANGUE ETRANGERE
X	X	X	X	X	MATHEMATIQUES
	X			X	RELIGION
X	X	X	X	X	SCIENCES SOCIALES
X	X	X	X	X	PHYSIQUE
X	X	X		X	CHIMIE
X	X	X		X	BIOLOGIE
X	X		X	X	LATIN
X	X		X	X	GREC
	X	X	X	X	EDUCATION PHISIQUE
X	X		X	X	MUSIQUE
X			X	X	ARTS PLASTIQUES
X	X		X		PHILOSOFIE
X	X		X		SCIENCES NATURELLES
X			X		ECONOMIE
			X		TECHNOLOGIE
	X		X		LANGUE REGIONALE
	X		X		E.A.T.P.
X	X	X			LITTERATURE
		X			ASTRONOMIE
		X			FORMATION LABORALE
		X			FORMATION PREMILITAIRE
	X	X			DESSIN
	X				ETIQUE ET MORALE
	X				HISTOIRE DE L'ART
	X				GEOLOGIE
X					PSYCHOLOGIE
X					ORGANISATION D'ENTREPRIS.
X					ETUDES SCIENTIFIQUES
X					COMPUTATION

LE CODE DES MATIERES INCLUES DANS LES STRUCTURES CURRICULAIRES DES PAYS ETUDIES

LEMAT (Langue maternelle), LEEXT (Langue etrangère), MATEM (Matematiques), REILG (Religion), CISOC (Sciences sociales), FISIC (physique), QUIMIC(chimie), BIOLO(Biologie), LATIN, GRIEG (grec) DEPOR(education phisyque), MUSIC (musique), ARPLA (Arts plastiques), FILOS (philosophie), CINAT(sciences naturelles), ECONO - (Economie), TECNO (Technologie), LENRE (langue regionale), EATOP (E.A.T.P.) LITER (Litterature), ASTRO (Astronomie), FORLA (formation premilitaire), DIBUJ (dessain), ETIMO (etique et morale), — HISAR (histoire de l'art), GEOLO (geologie), PSICO (psychologie) ORGEM (organisation d'entreprises), ESCIE (études scientifiques) COMPU (Computation) ;



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COORDENNEES DES ELEMENTS
0 1 5

RANG      FACTEUR 1  FACTEUR 2  FACTEUR 3  FACTEUR 4

LEMAT        .3889    ¯.0680    ¯.0366      .2286
LEEXT       ¯.1455     .0598     .0677      .1344
MATEM       ¯.1455     .0598     .0677      .1344
RELIG        .0459    ¯.0005    ¯.4976      .8140
CISOC       ¯.1455     .0598     .0677      .1344
FISIC       ¯.1455     .0598     .0677      .1344
QIMIC       ¯.3887     .0833    ¯.3544      .2269
BIOLO       ¯.3887     .0833    ¯.3544      .2269
LATIN        .3889    ¯.0680    ¯.0366      .2286
GRIEG        .3889    ¯.0680    ¯.0366      .2286
DEPOR       ¯.3411    ¯.2661     .3114      .2876
MUSIC        .3889    ¯.0680    ¯.0366      .2286
ARPLA        .5167 .   .3826     .1800      .5202
FILOS        .4899    ¯.0302     .0540     ¯.4533
CINAT        .4899    ¯.0302     .0540     ¯.4533
ECONO        .7320     .6646     .4243     ¯.3568
TECNO        .8271    ¯.0342    1.7558     ¯.2356
LENRE        .4165    ¯.7269     .5346^    ¯.4409
EATEP        .4165    ¯.7269     .5346     ¯.4409
LITER       ¯.5469     .1715    ¯.3497     ¯.4555
ASTRO      ¯2.2834     .5708     .4848     ¯.2421
FORLA      ¯2.2834     .5708     .4848     ¯.2421
FOPRE      ¯2.2834     .5708     .4848     ¯.2421
BIBUJ      ¯1.1388    ¯.4245    ¯.1009     ¯.4442
ETIMO        .0058   ¯1.4197    ¯.6866     ¯.6463
HISAR        .0058   ¯1.4197    ¯.6866     ¯.6463
GEOLO        .0058   ¯1.4197    ¯.6866     ¯.6463
PSICO        .6368    1.3633    ¯.9872     ¯.4781
ORGEM        .7320     .6646     .4243     ¯.3568
ESCIE        .6368    1.3633    ¯.9872     ¯.4781
COMPU        .6368    1.3633    ¯.9872     ¯.4781


COLONNE   FACTEUR1   FACTEUR 2  FACTEUR 3  FACTEUR 4

B.I.         .3892     .6587    ¯.3482     ¯.1652
ESPAN        .0035    ¯.6857    ¯.2635     ¯.2232
URSS       ¯1.3957     .2758     .1861     ¯.0836
FRANC        .5056    ¯.0165     .6737     ¯.0814
ALEMF        .0526    ¯.0876    ¯.1184      .7856
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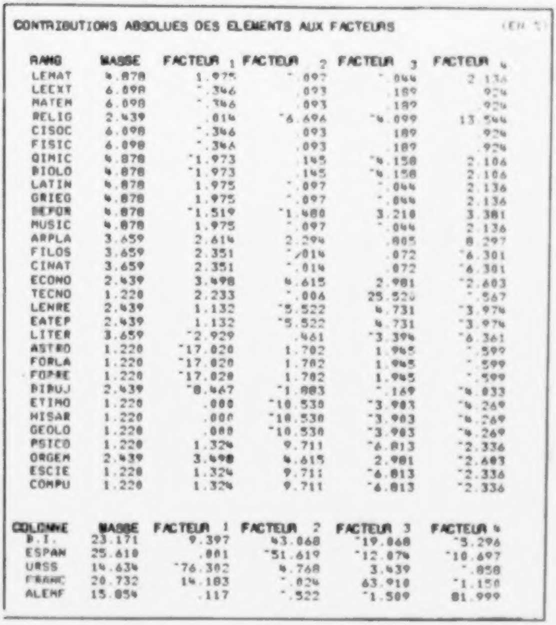

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CONTRIBUTIONS ABSOLUES DES ELEMENTS AUX FACTEURS                (EN %)

  RANG      MASSE   FACTEUR 1 FACTEUR   2  FACTEUR  3  FACTEUR 4
  LEMAT     4.878      1.975      ¯.097       ¯.044       2.136
  LECXT     6.098      ¯.346       .093        .189        .924
  MATEM     6.098      ¯.346       .093        .189        .924
  RELIG     2.439       .014     ¯6.696      ¯4.099      13.544
  CISOC     6.098      ¯.346       .093        .189        .924
  FISIC     6.098      ¯.346       .093        .189        .924
  QIMIC     4.878     ¯1.973       .145      ¯4.158       2.106
  BIOLO     4.878     ¯1.973       .145      ¯4.158       2.106
  LATIN     4.878      1.975      ¯.097       ¯.044       2.136
  GRIEG     4.878      1.975      ¯.097       ¯.044       2.136
  DEPOR     4.878     ¯1.519     ¯1.400       3.210       3.381
  MUSIC     4.878      1.975      ¯.097       ¯.044       2.136
  ARPLA     3.659      2.614      2.294        .005       8.297
  FILOS     3.659      2.351      ¯.014        .072      ¯6.301
  CINAT     3.659      2.351      ¯.014        .072      ¯6.301
  ECONO     2.439      3.498      4.615       2.981      ¯2.603
  TECNO     1.220      2.233      ¯.006      25.520       ¯.567
  LENRE     2.439      1.132     ¯5.522       4.731      ¯3.974
  EATEP     2.439      1.132     ¯5.522       4.731      ¯3.974
  LITER     3.659     ¯2.929       .461      ¯3.394      ¯6.361
  ASTRO     1.220    ¯17.020      1.702       1.945       ¯.599
  FORLA     1.220    ¯17.020      1.702       1.945       ¯.599
  FOPRE     1.220    ¯17.020      1.702       1.945       ¯.599
  BIBUJ     2.439     ¯8.467     ¯1.803       ¯.169      ¯4.033
  ETIMO     1.220       .000    ¯10.530      ¯3.903      ¯4.269
  HISAR     1.220       .000    ¯10.530      ¯3.903      ¯4.269
  GEOLO     1.220       .000    ¯10.530      ¯3.903      ¯4.269
  PSICO     1.220      1.324      9.711      ¯6.813      ¯2.336
  ORGEM     2.439      3.498      4.615       2.981      ¯2.603
  ESCIE     1.220      1.324      9.711      ¯6.813      ¯2.336
  COMPU     1.220      1.324      9.711      ¯6.813      ¯2.336

COLONNE     MASSE  FACTEUR 1  FACTEUR  2  FACTEUR 3  FACTEUR 4
   B.I.    23.171      9.397     43.068    ¯19.068     ¯5.296
  ESPAN    25.610       .001    ¯51.619    ¯12.074    ¯10.697
  URSS     14.634    ¯76.302      4.768      3.439      ¯.858
  FRANC    20.732     14.183      ¯.024     63.910     ¯1.150
  ALEMF    15.854       .117      ¯.522     ¯1.509     81.999
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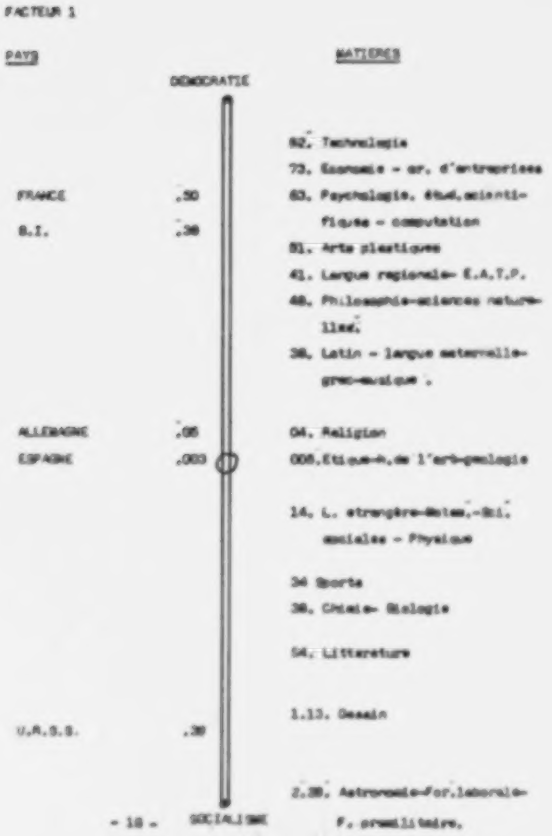
4. Graphiques et interpretations de l'analyse factoriel des correspondances.


FACTEUR 1
PAYS
MATIERES
DEMOCRATIE
82. Technologie
73. Economie - or. d'entreprises
FRANCE .50
63. Psychologie, étud.scienti-fique - computation
B.I. .30
81. Arts plastiques
41. Langue regionale- E.A.T.P.
48. Philosophie-sciences naturelles.
38. Latin - langue maternelle-grec-musique .
ALLEMAGNE .05
04. Religion
ESPAGNE .003
006.Etique-h.de l'art-geologie
14. L. etrangère-Mathem.-Sci. sociales - Physique
34 Sports
38. Chimie- Biologie
54. Litterature
1.13. Dessin
U.R.S.S. .30
2.38. Astronomie-For.laborale-F. premilitaire.
SOCIALISME

Dans l'ensemble des matières qui se présentent dans ce travail nous croyons opportun de faire une subclassification pour pouvoir procéder avec plus de précision à l'analyse factorielle. Nous regroupons les matières en 4 grands blocs, en nous remettant au critère d'identité professionnelle.

a) Formation personnelle sociale et humaine: (Psychologie, arts plastiques, philisophie, latin, grec, musique, langue régionale, réligion, étique, histoire de l'art, littérature, sciences sociales, éducation physique).

b) Formation de basse pour la technique: mathématiques, chimie, biologie, dessin, géologie, sciences naturelles, astronomie).

c) Formation spécifiquement technique: (E.A.T.P. technologie, computation, études scientifiques).

d) formation pour la technique appiliquée:
   1) Dans une économie libre démarchée (économie, organisation d'entreprises).
   2) Dans une économie planifiée (formation laborale et prémilitaire).

5. Analyses factorielles de correspondances

Facteur 1

Democratie - socialisme

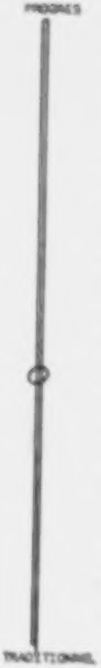
Les facteurs distribuent les pays en deux sortes de groupes qui expriment la concomitance entre pays et matières selon qu'ils sont des pays démocratiques occidentaux ou la U.R.S.S..

Nous ne procedons pas à l'analyse "Formation personnelle sociale et humaine" pour échapper à l'intérêt de notre travail.

En ce qui concerne le groupe nommé "Formation de Base" pour la technique nous pouvons constater que: Dans un premier lieu les deux groupes de pays (mat. ph. ch. et biologie).

En second lieu il y a des matières qui apparaissent exclusivement unies à l'Espagne (la géologie) et à la URSS (l'astronomie). Nous pensons que cette matière démontre le grand intérêt de la URSS pour la connaissance et la domination de l'espace.

FACTEUR 2



PAYS	
G.B.	.60
U.R.S.S.	.27
France	.01
Allemagne	.08
Espagne	.80

MATIERES	
1.38	Psychologie- E. scientifique-computation
.88	Economie-Org.d'entreprises
.77	Astronomie-F.laborale-F. premilitaire
.38	Arts plastiques
.17	Litterature
.09	Chimie-Biologie
.08	L.Etrangere-Mathem.Sci.Sociales-Physique-/
.03	Scie.naturelles-Technologie Philosophie
.08	L.Maternelle-Latin-Grec-Musique
.38	Sport
.42	Dessin
.72	Langue regionale-E.A.T.P.
.80	Religion
.41	Ethique- H.de l'art-Geologie

Quand au bloc nommé "Formation spécifiquement technique" toutes les matières intégrantes de celui-ci apparaissent plus unies à la France et à B.I. pays qui forment le bloc démocratique.

Quand au paragraphe "Formation pour la technique appliquée" on peut apprécier la grande dichotomie entre les pays qui ont une économie de libre échange dans lesquels on favorise des matières comme l'économie et l'organisation d'entreprises et les pays qui ont une économie dirigée pour former l'homme collectif et national où priment les matières comme formation laborale et pré-militaire.

Facteur 2

Progrés - traditionnel

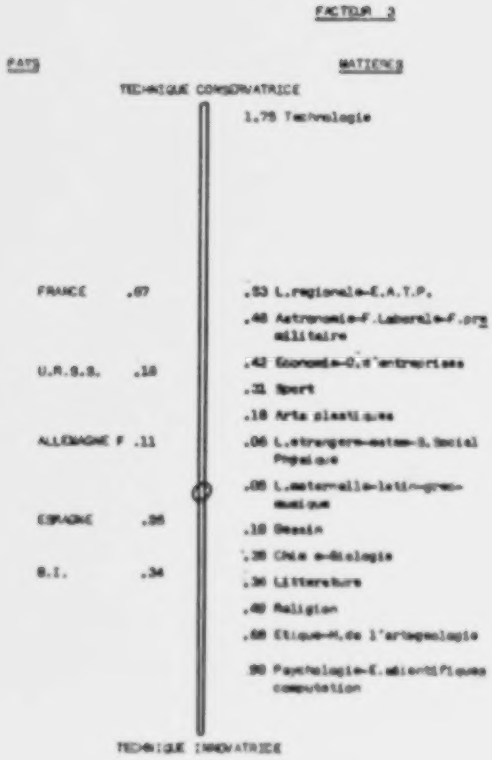
Le facteur regroupe les pays et les matières d'accord avec l'innovation plus ou moins grande dans les curricula.

Les pays avec des imposés curriculaires plus conservateurs montrent une grande concomitance avec les matières qui forment le groupe appelé formation personnelle sociale et humaine (L'Espagne et l'Allemagne).

De l'intervalle delimité par les valeurs 024 et 43.068 qui délimitent l'éspace entre l'origine et la plus importante valeur du facteur on peut placer les pays concomitants avec les matières qui forment les groupes appelés "formation spécifiquement technique" et "formation pour la technique appliquée", et c'est pour ça qu'on peut dire que "technique aboute a progrés". Cependant on peut voir que tous ces pays avec un haut degré de technification curriculaire n'oublient d'une manière plus au moins importante les matières de formation humanitaire on peut remarquer comme seule exception la URSS qui montre un curriculum qui donne d'importance à la formation de l'homme travailleur.

La plus importante nouveauté curriculaire est présentée par la B.I. et la URS qui rompent d'une certaine manière les modèles curriculaires traditionnels.

La France qui est placée à l'origine présente un curriculum plus intégré aux 2 tendences L'Allemagne et L'Espagne présentent un moindre degré d'innovation curriculaire.


FACTEUR 3
PAYS
MATIERES
TECHNIQUE CONSERVATRICE
1.75 Technologie
FRANCE .07
.53 L.regionale-E.A.T.P.
.46 Astronomie-F.Laborale-F.org militaire
U.R.S.S. .16
.42 Economie-O.d'entreprises
.31 Sport
.18 Arts plastiques
ALLEMAGNE F .11
.06 L.etrangere-autres-S.Social Physique
.05 L.maternelle-latin-grec-musique
ESPAGNE .26
.18 Dessin
B.I. .34
.28 Chimie-Biologie
.36 Litterature
.49 Religion
.68 Etique-H.de l'artegeologie
.90 Psychologie-E.scientifiques computation
TECHNIQUE INNOVATRICE

Facteur 3

Lauda 1973 - Explicat 1683

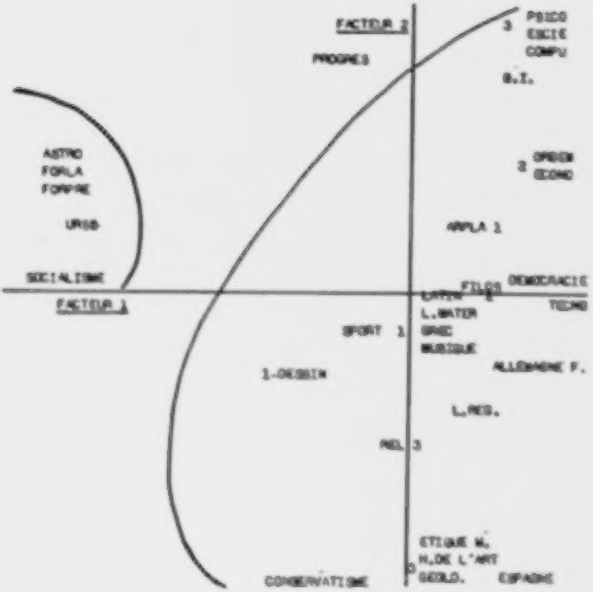
Technique conservatrice - Technique innovatrice

Le facteur forme 2 grands groupes, celui des matières techniques traditionnelles versus les matières techniques innovatrices.

Les matières qui ont fait partie traditionnellement des structures curriculaires forment une image autour de l'origine malgré qu'ils perdent des valeurs absolues à son placement c'est facile de voir comment sont placées la France et la B.I. avec des poids en ordonnées et en valeurs absolues très importantes dans la distribution du facteur. Bien que l'Espagne nous soit montrée comme un pays conservateur par sa structure curriculaire bien qu'il ait tendance vers l'innovation et pas vers la technique traditionnelle.

La URSS, par son placement ou facteur, nous apparaît comme un pays avec une haute tendence à la technique.

Par contre l'Allemagne est placée presque à la valeur d'origine, ça veut dire qu'elle participe autant d'un groupe de matière que d'un autre et elle se manifeste comme l'Espagne plus inclinée à la technique innovatrice qu'à la traditionnelle.


FACTEUR 2
PROGRES
3 PSICO
SOCIE
COMPU
O.I.
ASTRO
FORLA
FORPRE
2 ORDIN
ECONO
URSS
ARPLA 1
SOCIALISME
FILOS
DEMOCRACIE
FACTEUR 1
LATIN 2
TECNO
L.MATER
SPORT 1
GREC
MUSIQUE
ALLEMAGNE F.
1-DESSIN
L.REG.
REL 3
ETIQUE M.
H.DE L'ART
0
GEOLO.
ESPAGNE
CONSERVATISME

Facteur 1 et 2

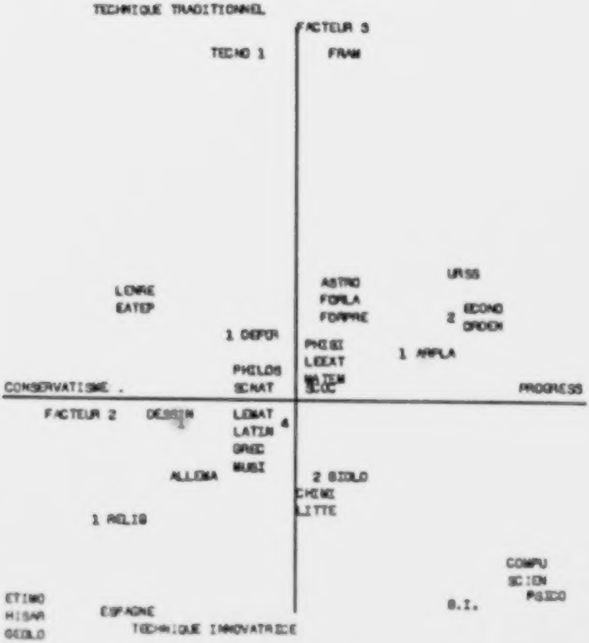
Quand nous croisons les facteur 1 et 2, on nous a regroupé aux pays du groupe democratique et B.I. institution qui continue à apparaitre avec un curriculum plus innovateur. Il apparait aussi avec des valeurs absolus très rreprésentatifs la Russie tous les deux sont placés au dessus de l'origine bien qu'ils restent placés dans des différents axes coordonnées.

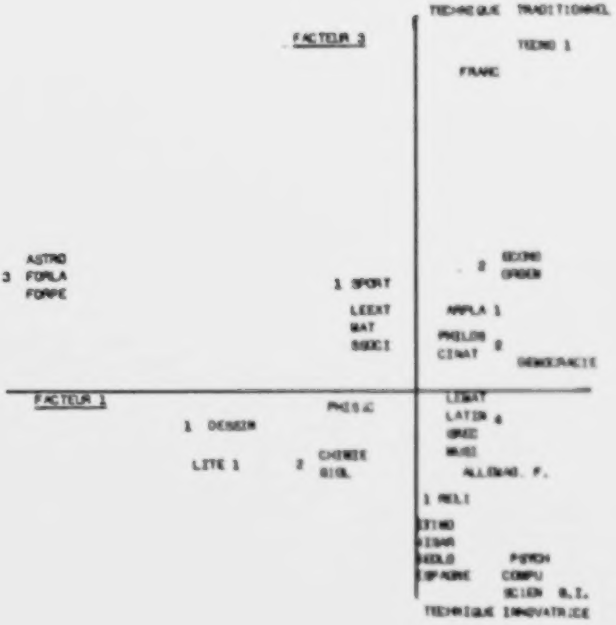
Les deux systèmes sont placés vers l'orientation progrès et ça est complétement logique, parce que ça avait été démonstré quand on avait analysé le facteur 1, parce que les deux avaient présenté la même caractéristique innovatrice.

Cependant ils montrent un absolu affrontement face au axes de coordonnées appelées Démocratie - socialisme et pour ça on constate une fois de plus la grande coherence démontré par les différences curriculaires en fonction des idéologies des différents pays étudiés.

Facteur 2 et 3.

Quand on croise le facteur 2 versus 3, nous trouvons que les axes appelées techniques conservatrice progrès agglutinent, bien qu'avec de très différents valeurs en coordonnées. La France, la URSS tandis que le B.I. est placé au axe de coordonnées appelés progrès - technique innovatrice. On pouvait attendre après les analyses réalisés que l'Espagne et l'Allemagne seront placées au quadrant conservatrice - technique innovatrice, parce que on a déjà montré ce tendance dans d'autre analyses.


TECHNIQUE TRADITIONNEL
FACTEUR 3
TECNO 1
FRAN
URSS
ASTRO
FORLA
FORPRE
LENRE
EATEP
2 ECONO
ORDEN
1 DEFOR
PHISI
LEEXT
1 ARPLA
PHILOS
SCNAT
MATEM
SCOC
CONSERVATISME .
PROGRESS
FACTEUR 2
DESSIN
LEMAT
LATIN
GREC
MUSI
4
ALLEMA
2 BIOLO
CHIMI
LITTE
1 RELIG
COMPU
SCIEN
PSICO
B.I.
ETIMO
HISAR
GEOLO
ESPAGNE
TECHNIQUE INNOVATRICE


TECHNIQUE TRADITIONNEL
TECHNO 1
FRANC
FACTEUR 3
ASTRO
3 FORLA
FORPE
1 SPORT
LEEXT
MAT
SOCI
2 ECONO
ORDIN
ARPLA 1
PHILOS
CINAT 2
DEMOCRATIE
FACTEUR 1
PHYSIC
LATIN 4
GREC
MUSI
ALLEMAG. F.
1 DESSIN
LITE 1
2 CHIMIE
BIOL
1 RELI
ESPAGNE
PSYCH
COMPU
SCIEN B.I.
TECHNIQUE INNOVATRICE

Facteur 1 et 3

Quand nous confrontons les facteurs 1 et 3, nous ne trouvons aucune donnée relévatrice, parce qu'on nous regroupe au quadrant technique conservatrice démocratie - technique et sépare d'un côté, les pays avec un régime démocratique et la B.I. et d'un autre tandis que la URSS est placée dans le quadrant technique conservateur socialiste près des matières qui agissent comme différenciatrices dans leur structure curriculaire.

Au "cluster" des matières les groupes homogènes restent formés comme suit:

Groupe 1: Psychologie, ordinateurs et études scientifiques ces matières appartiennent seulement au Baccalauréat International. Elles sont montrées comme des éléments qui marqueront les différences. Le Cluster de ce groupe est homogène.

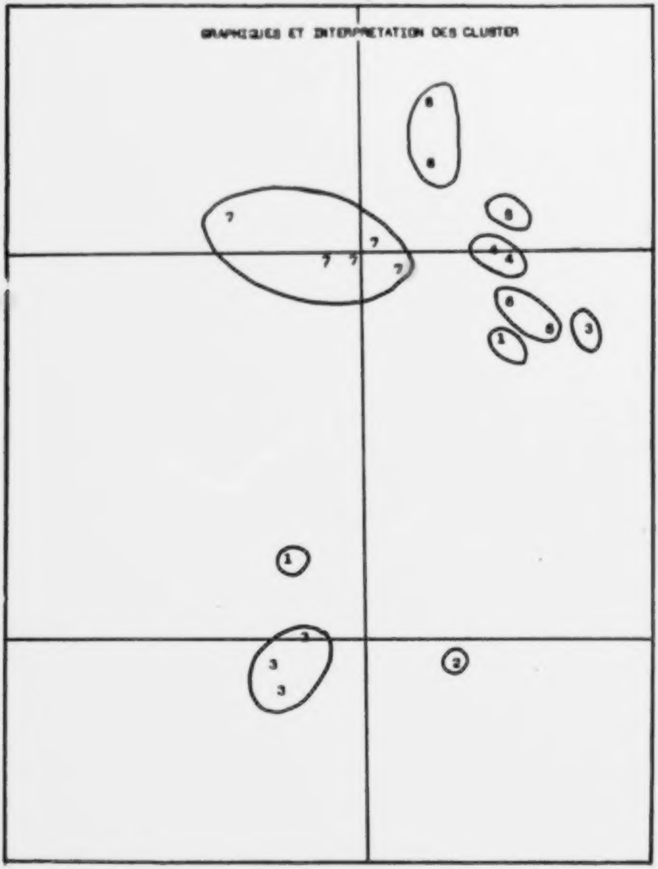
Groupe 2: Astronomie, Formation laboratoire et formation prémilitaire apparaissent aussi comme des matières en grande manière différentielles de ce groupe arrive exactement la même chose qu'au groupe antérieur que le Cluster du groupe est homogène. Ce groupe disparaît au résumé graphique des cas significatifs, ça nous démontre que ce sont des matières qui ne communiquent pas avec tandis des curricula soumis à l'étude.

Groupe 3: Technologie, cluster homogène.

Groupe 4: Latin, Grec, musique, philosophie, sciences naturelles et langue maternelle formant un groupe de cluster résultant n'est si homogène qu'aux groupes décrits avant.

On peut penser que la matière sciences naturelles fonctionne dans le groupe comme aglutinant d'un ensemble de matières (Physique, chimie, biologie...) qui après diversifieront et formeront ensemble un groupe dans le cluster.
D'un autre côté ces matières forment le groupe que nous pourrions appeler matières optatives ou différentielles de specialités aux pays soumis à l'étude.

Groupe 5: Ce groupe est formé avec les matières de: enseignements et activités techniques professionnelles et langue régionale. Le Cluster de ce groupe est aussi homogène. Les éléments (pour déterminer les différences) envers les autres groupes.



PLAN RESUMÉ DES CENTRES DES CLUSTER

Groupe 6: Arts plastique, économie, et organisation d'entreprises homogénisent un autre groupe.

Groupe 7: Sciences sociales, physique, chimie, biologie, littérature, langue étrangère, mathématiques, dessin, et sports. Le groupe bien qu'on nous le montre comme le moins homogène de tous ceux qu'on a analysés s'érige comme le groupe de matières plus communes dans tous les curricula analysés sauf le dessin qu'avec cette enseigne seulement est donné en U. Soviétique et en Espagne, on nous la montre comme une variable mais peu explicative.

Groupe 8: Ce groupe est formé en grande manière par des matières qui sont données seulement en Espagne sauf la Religion qui est partagée avec le Système Educatif Allemand.

Quand on a un plan de tous les centres des cluster c'est évident que tous les groupes de matières configurées par l'analyse ont quelque relation les uns avec les autres sauf le groupe formé par l'ensemble de matières exclusives de la URS qui ne transmet aucun groupe de cluster le plus éloigné du point d'origine est le VIII ce qui nous démontre que les matières de l'Espagne ne sont pas partagées par aucun autre groupe. Le cluster VII est le moins homogène de tous ceux que nous avons analysés et ça est parfaitement compréhensible parce que les matières obligatoires doivent obligatoirement former un groupe mais a structure et sa conception scientifique sont très différentes.

Au cluster des pays les groupes homogènes restent formés de la manière suivante:

Groupel - La URS
Groupe 2 - Baccalauréat International
Groupe 3 - La France, L'Allemagne, L'Espagne

Au plan résumé des cluster des pays nous pouvons voir que des trois groupes clairement différents le 1 et le 2 sont homogènes tandis que le groupe formé par la France, l'Allemagne et l'Espagne bien qu'ils ne soient pas clairement homogènes ils nous montrent l'évidence que les 2 systèmes éducatifs sont contagiés.

C'est le français qui se différence le plus.

Le Baccalauréat International, bien qu'il se dessine comme groupe quand on analyse les distances des groupes par rapport à l'origine se place plus proche de l'Espagne, la France, et l'Allemagne que de la URSS qui se montre totalement différente.

Conclusions

a) Ca nous inquiète que le Baccalauréat International qui se place sur un axe du progrès, s'approche pour certains cas mais il ne réussit jamais à contagier ceux qui ont été sélectionnés pour notre étude.

b) L'Espagne participe à toutes les structures mais elle ne se définit pour aucun modèle cocrètement. En nous situant en accord avec l'analyse factorielle effectuée antérieurement dans un secteur conservateur bien que parfois il montre une petite tendance à l'innovation.

c) Il faudrait recommander que le vecteur conformé pour des matières techniques innovatrices forment une partie de la structure curriculaire espagnole.

d) On ne détecte pas de différences basiques curriculaires entre les pays centralisés et regionalisés, sauf l'URSS qui se montre particulièrement différente du reste du groupe.

e) On peut constater clairement que les 2 modèles de société (socialisme et démocratie), bien que ce ne soit que par l'intitulé des matières puisqu'en URSS les matières qui montrent que l'action éducative va configurer à l'homme en esprit marxiste- leniniste ressortent.

f) L'Espagne se contagie des structures curriculaires des pays qui appartiennent au Marché Commun en mettant en evidence une approximation plus grande en Allemagne.

g) Les curricula doivent tendre à répondre plus impétueusement aux besoins technologiques économiques et scientifiques qui surgissent dans les sociétés actuelles de façon à ce que les matières comme l'astronomie, l'informatique, les études scientifiques etc... apparaissent clairement explicites dans tous les curricula.

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TECHNOLOGY'S IMPACT ON RELATIONSHIPS BETWEEN GENERAL EDUCATION AND EDUCATION FOR CAREERS

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Europe went to school in the 19th century. At that time the Industrial Revolution multiplied material goods for domestic consumption and export. Overall prosperity increased. It is easy to see the correlation between the spread of compulsory education and industrialisation. But which is the cause, and which is the effect? Or can we find a third common factor explaining both of them?

The Industrial Revolution was a mechanical revolution which mechanized craft skills into mass production techniques. Machines took over the mechanical skills and muscle functions of the labourer. Working for wages broke the family as a traditional unit of socialisation. Work processes and the social organization of work changed the way of life of the workers fundamentally. Both at work and outside it new kinds of skills and abilities were demanded. The systematisation of compulsory primary education was needed to create the job qualifications of the new era, the Second Wave, in individuals. This put an end to the old image of education with its inherent value.

Education was transformed into a commodity with use value, because schooling was able to create skills that one needed in word processes, i.e. work qualifications. A young Finnish scholar has analyzed, in his doctoral thesis, what these qualifications could have been.

1) intensity qualifications refer to punctuality, endurance, achievement motivation, competitive spirit, belief in the inviolability of private property, etc.
2) productive qualifications refer to manipulative skills (machines, raw materials) and skills in human relations, e.g. empathy and cooperative skills
3) innovative qualifications refer to the development of work processes by increasing productivity.

The first group consists of more or less general qualifications and the second one, which is usually meant in connection with industrialization, consists of specific skills. The emphasis is of course a bit different according to the target group, whether it is wage labourers, non-productive wage labourers or non-wage labourers.

However, general schooling was more socio-political than pedagogical or economic in nature and more political (educating citizens for nation states) than emancipatory. In fact, skills needed during the time of the guild system exceeded those of early industrialization. One has to give a broad meaning to the term 'qualification'. It refers also to individual competences which are prerequisites for activities outside the labour process. Legislation against child labour made children a functionally unnecessary stratum. It was school that rescued them. School was a means of conquering poverty and sloth. It was the best possible agent to indoctrinate children with nationalism and new political ideas. It was the institution, which was created just at the right time, to give legitimacy to inequalities of awakening democracy.

How relevant have the skills which have been taught at school been to the progress of industrialization? The dual theory of work argues against functionalism. It says that qualifications are culture bound and characteristics of jobs, not workers. Education is mainly a screening device for social differentiation. It cools down individual aspirations and expectations and builds up an educational hierarchy to match the social and economic inequalities. Education has even lost its use value. It is a commodity to be sold and bought for its exchange value. And now we are experiencing an excessive supply of the commodity. Education and training have an unattainable goal. But we do not suffer from the inflation of education, but the inflation of degrees and certificates. We are almost dying of credentialism and degree disease.

Nevertheless, school has become and continues to be the gatekeeper to the world of work. But wage-work is becoming scarce. People talk of the crisis of the work society that is organized according to the Protestant work ethic. In the first phase of the transition, agricultural and industrial workers, rendered unnecessary by automatization and rationalization, could be replaced in service industries. The second phase was brought about by robots and automatic data processing. But still the redundant workers could find jobs, after quite a long transition period it is true, in the budding information society producing, manipulating, circulating, storing, and even planning to make a profitable use of information. But each new generation of computers, each new device of communication, each new crisis in the world economy etc. reduce the demand for labour even in the tertiary sector.

Producers have to remove the risk of human error, i.e. to remove human beings. The public sector can no longer absorb either the younger generations of highly qualified graduates or the older less highly trained workers, because the magic combination of three letters, GNP, no longer shows green. The massive socio-political reforms, initiated in the period of rapid growth in the 60's and 70's start to show up in national economies with all their power exhausting the resources of the Welfare State. And, nevertheless, political pressure to go on with reforms is as strong as ever before. So the politicians keep selling education as an investment for a better life in the world of work. They still believe in production, and production believes in formally qualified manpower. It must be most productive in the "Third Wave" jobs in post-industrial information society.

The rapid development of a new technological culture and the impact of technological change on the economy and jobs must be reflected in educational programmes. So almost every country has instituted more work-oriented curricula, has expanded vocational education programmes, has set up efficient guidance and counselling services, has adopted Computer Assisted Instruction Systems, etc. But often this is not planned action but reaction to the change that has been initiated somewhere else. There are no alternatives, because "we must not fall behind our competitors". In a way technology has got out of the hands of its users. It has become a closed circle: all the answers to the problems caused by technology have to be found within technology. Thanks to the ingenuity of Man we are about to step from the Welfare State into the Fulfilment State.

But as far as education is concerned there exists a great disequilibrium on the one hand and a widespread reluctance to make changes on the other. Vocational training still rests on Taylorism although most people make their living in service industries. Many planners still believe that there exists a 1:1-relation between work and training. Many politicians still make the Young believe that the more people are educated the more job openings will show up. No reform of education, no extra provision for education can by themselves provide new job openings or a better match between qualifications and a changing labour market. And it is not a question of scarce job openings resulting from economic recession. There will be only a limited number of work opportunities demanding skills in high technology and in information processing. Polarisation is not just a sociological concept. It is reality. People have still to labour at routine tasks in huge white and blue collar bureaucracies.

Of course we need our experts and specialists. We must have all education for some, although demanding elite education may sound like blasphemy, because education should be the great equalizer. But we also need some education for all. To be a specialist one has to be a generalist. The top jobs at the high level of technology are often relatively narrow and untheoretical. This means that the skills very easily become outdated. To renew their knowledge base experts must be innovative, they must have a high level of general education. And so must "the ordinary people" who have to make sense of the changing world.

The key issue in future education is not technology itself but change, of which technology is only a part. The old idea of education as a device for building patterns of behaviour must be rejected. We must always be prepared to cast out old patterns and adopt totally new ones. In fact we have to forget what we have previously learnt. Political, economic, and labour institutions are changing drastically. So must education change too, but not because of the world of work. Education must prepare us socio-politically for a new society, as it had to do 150 years ago.

If productivity is the be-all and end-all and machines and electrons are more efficient in achieving it, we have to revise what we mean by work. The Industrial Revolution didn't increase leisure for the working class, but the Information Revolution will. What we need now is a non-work ethic as the late Lord Ritchie-Calder put it. And non-work doesn't refer to sloth, the deadly sin of the Protestant work ethic, but to retirement, redundancy, unemployment, a shorter working day and week, longer holidays with pay; it means time for ourselves, to be personally creative and productive.

Ritchie-Calder reminds us that our freedom from the slavery of paid jobs may first tempt us into selfindulgence and wise idleness, but then we start to seek virtue in our duty to our fellow men and in service to good causes. Job openings will be permanently lacking, but many meaningful activities will be found. Education must prepare us for that, for the uncertainties of life and of the whole world. We must learn to anticipate life's rapid changes. Instead of what and how-questions we must ask more often why. The purpose of education is not to produce masses of specialists at the age of under 20 or 25. In many countries children and young people spend more than 16 years in full-time initiated education. Some do not enter the work life until they are middle aged, some never enter it. So half a life is spent in preparation for - nothing! Instead of that, school should cultivate the natural curiosity and doubt in every child so that he keeps asking questions throughout his life, not for production but for himself, to make his life meaningful by coping with and anticipating the changes of society.

One has to make a deep and meaningful distinction between education and training, and I needn't say which comes first. If education is going to regain its use value, it has to give us more life skills instead of job qualifications: risk-taking and decision making, self-reliance, persistance and tolerance, problem solving capacity, creativity, understanding of self and society, manual dexterity, language skills, both leadership skills and cooperation skills, flexibility. Job qualifications can be built afterwards on these broad qualifications on a life long basis. Learning is an ongoing process, never complete. So is the world of work. It may be wisest to see employment and training policies, general and vocational education, in terms of social integration, connecting individual aspirations and lives to life opportunities and social institutions. We must remember that education is not a political concept, as schooling is; it is pedagogical and emancipatory. It is not a group concept, it is individual. Schooling is an input in the modern socialization process. We must take care that the output will be education.

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COMMUNICATION TECHNOLOGY AND ITS EDUCATIONAL IMPLICATIONS FOR THE OLDER ADULT LEARNER

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1. Introduction

In recent time a variety of delivery systems and technologies, developed for the home television set, provide the television user with increasing programming alternatives. For example cable television, the widest spread of these alternatives in the U.S., is characterized by programming brought to the viewer via a cable (oneway cable television); there is no longer the problem of interference between the messages televised over air. One consequence of cable television is that the number of channels is now nearly unlimited.
Another innovation with yearly growth rates of 50 percent and more is video cassette recorders (VCR). These recorders allow the viewer to replay, to record, and, in combination with a video camera, to produce a nearly unlimited variety of programmes.

In 1983 36 percent of the U.S. television households were basic cable subscribers and 21 percent pay cable subscribers (note that the basic and pay subscriber can be one and the same). The estimates for 1990 are that 90 percent of all households having televisions will be passed by cable, 54 percent, basic, and 35 percent, pay cable (Cable Vision, 1985, 48). For these reasons, the focus of this paper will be on cable television and video recorders.

A central assumption regarding these new developments in home television is that they will lead from broadcasting to narrowcasting (Naisbitt 1982, 273). Narrowcasting is programmeming for smaller audiences having specific backgrounds and/or interests in common (for example, older adults). According to Toffler (1980 180), these technological innovations have one thing in common: "they slice the mass television public into segments, and each slice not only increases our cultural diversity, it cuts deeply into the power of the networks that have until now so completely dominated our imagery" (see, for example, Nielson, 1982-84; and Naisbitt, 1982).

This raises the following questions:

1) What are the potential roles or implications of narrowcasting for the increasing group of the elderly in the American society?
2) What is the educational potential of these innovations for older persons?
3) What are the risks of the recent innovations of telecommunication for the elderly?

2. Roles and implications of narrowcastings

A great potential for future growth is predicted for videocassette recorders (VCR). In June 1982, VCRs reached a market penetration of 4,7 percent (Beardsley 1981, 128). The prognosis is that there will be 25 million VCRs in U.S. homes by the end of 1985 (Ames and Fabrikant 1985, 55).

The VCR also may have some consequences concerning the transience of television broadcasts, and the "catchitormissit" nature of the live broadcast or even low power television (LPTV) consumption (Levey and Fink, 1984). Television programmeming can be stored by the VCR even if the individual who is recording is not at home. Then the recorded programme can be viewed whenever the user wants to. In general, everything that is available on television, over the air, or via cable or satellite can be stored with VCRs.

Research on the elderly's television consumption found that older persons, on the average, phase out an hour earlier (between 9:30 and 10:00 p.m.) than younger viewers (Davis and Davis 1985, 139). Sometimes programmes for specific interest groups like the elderly are broadcast at a time unfavourable for them (at late night or early afternoon), when there is a competition with other activities, at times more important and personally satisfying, like shopping during daylight, settling affairs with welfare agencies, visiting the doctor, walking in the park, or meeting with friends. Thus, the VCR technique may increase the independence of elderly persons' lives. For example, allowing them to use daytime for active behaviour and social contacts. For educational purposes this technique has another advantage compared with "live" televised instruction. The presentation stored on cassette can be interrupted and replayed whenever the student desires or needs it. This may be important, considering the lower speed of information processing, for a part of the elderly and the increasing likelihood of their getting mentally tired in old age (Botwinick 1977?, Schaie 1983). Since the cassettes can be easily distributed, almost everything in television rich environments is now also available in limited television environments. Cassettes may create a market for highly specialized interests scattered across the country (Ames and Fabrikant 1985, 55). However, the actual problem remaining is that the costs for recorded cassettes, a VCR, and a video camera are still prohibitive for the average household (Baldwin and McVoy 1983, 343)

Cable television is a "narrowcast system of distributing one or more television signals over a wired system to individual receivers in a given geographic area" (Cohen 1984, 388). What are the promises and hopes associated with cable television? The increase in diversity takes first rank; there are now many channels available. The newest cable systems have 108 channels; and with the broadband and fiberoptic cable, this number is still increasing. Feeding these channels with software will inevitably lead to a greater variety of programmeming for more and more specific interest and target groups. This will also put an end to the quasi monopoly of the broadcasting companies with a tight market for creative talents. There will be room for experimentation with new ideas, for more indepth news instead of the traditional headline service of the networks, and less commercial interruptions. The closed shop of the broadcast market will be opened, not only by the number of available channels but by the public access channel as well. This characteristic may contribute to televisions becoming more interactive. New areas for community services and education will be set up (Baldwin and McVoy 1983, 343).

Davis and Miller (1983) mention the following possible uses of cable television by older adults: general information like news and public affairs, specialized information according to the needs and wants of older persons, general entertainment via several channels (video music is a growing market), ethnic and religious programmeming, community news and local politics.

This list of potential uses by Davis and Miller (1983) refers most to oneway cable. An example for twoway, or interactive cable, currently offered but still in the stage of experimentation (Praisly 1983) is the service videotext, a "system in which information is stored in a central computer and then transmitted to the home on phone lines or cable and displayed on the home TV set" (Woolley 1984, 123). The strengths of this system are that the users only display the information of interest to them , keeping it on the screen for as long as they want. The electronic storing of the information can be constantly updated and is available to all users 24 hours a day. An example of such a system is Viewtron, developed in the late 1970s. Available services included updated news, weather, sports information, information for ordering merchandise from catalogues, the ability to transfer money from bank accounts, send messages to a public bulletin board, and educational programmes like the Florida Driver's Test. Some of these services may contribute to save time for more interesting and creative activities or may lead to a more independent life style of certain subgroups like home bounds.

These are some potentials of those innovations. What about reality? A survey initiated by the National Retired Teachers Association and the American Association of Retired Persons concerning the use of and attitudes toward new technologies by the elderly was conducted in June 1981 (Kerschner and Chelsvig Hart 1984; Brickfield 1984).

Use of Technology by Age

		Age Group		
		45-54	55-64	65+
	(N)	(206)	(204)	(198)
Technology used		%[a]	%[a]	%[a]
Calculator		75	65	39
Cable TV		40	39	32
Computer		37	29	18
Video recorder		12	7	6
Automatic teller machine		19	14	10
Video games		29	14	12

[a] Percents sum to more than 100 because some respondents used more than one type of technology.

(Kerschner and Chelsvig Hart 1984, 136)

32 to 40 percent of the sample use cable television (37% in total), and 12 to 6 percent video recorders (8% in total). There is a countercurrent relationship between age and use of modern technology, a positive correlation with income and educational level. No significant correlation between sex and use of cable television was found.

Part two of the survey focused on the attitudes of older persons toward technology in general. Six statements were presented for agreement or disagreement. The results were as follows:

- 50 percent agreed "machines are doing too much that ought to be left for people to do,"
- 87 percent agreed "machines make life too impersonal,"
- 87 percent agreed "improvement in technology makes it possible to get things done faster and more accurately than ever before,"
- 34 percent agreed "life is going to be better when people are able to do banking, shopping, etc. from home by using telephones or cable television,"
- 50 percent agreed "using calculators, computers, and other electronic gadgets is usually too confusing to bother with,"
- 50 percent agreed "improvements in technology really have not made life easier, just more difficult to deal with" (Kerschner and Chelsvig Hart 1984, 139).

There is a negative correlation between age and attitudes toward technology, men had a more favourable attitude compared to women, and attitude was also affected by income, educational level, and residence.

One of the most interesting developments in cable television is the public access channel. "The public access channel, under the American notion of freedom of speech, is available to any resident of the community on a first come, first served basis, to communicate whatever is desired" (Baldwin and McVoy 1983, 94).

An example for the use of such a channel by the elderly is the project "Public Access Cabletelevision by and for Elders" (PACE). This project began in October, 1977 in San Diego and is currently still in progress. The intent of this project is to establish user-controlled television programmening in an urban setting which has one of the largest concentrations of elderly in the United States. The assumption is that members of this target group know their needs and wants best.

Eighteen months after the PACE project began, 95 older adults were trained in video production using a "How To" handbook produced for this purpose. Over 50 programmes were produced covering a wide range of topics proposed by seniors. A survey found that approximately five percent of the target group had seen a PACE programme (Real et al., 1980). Even if the number of viewers is small, and the number of the producers and "use controllers" is still smaller, this project demonstrated how the elderly can promote their interests.

Another case study concerning a new form of community participation with and for older adults was first approved (1975) and evaluated by Reading, Pennsylvania with the twoway video cable system. The objectives of the project were: (1) to establish three neighbourhood communication centres interconnected by cable television (the city hall and some schools were later interconnected as well); (2) to train citizens to operate the system; (3) to link together older adults and public agencies; and (4) to produce a twoway public service programme through which the elderly could communicate with each other and with service providers.

Starting with 1178 elderly, the programme was subsequently carried to all 35,000 subscribers of the Berks Community Television. One of the highlights during the experiment was the monthly, and later weekly, programme "Meet the Mayor." In this programme a twoway communication took place between the three communication centres and members of the city council. Moss's (1978a, 163) evaluation found an impact in three general areas: "awareness of community problems, knowledge about social services and involvement in social processes."

3. Educational television

The advances in storing and transmitting information (see Haefner 1983) have led to a new and increasing branch in the field of education. Instructional technology, multi media approach, computer assisted instruction, audiovisual school, television university, the living room as the classroom, distance learning are terms created in the fifties and sixties characterizing this trend of that time. A lot of educational optimism was associated with these developments, like replacing the "traditional, old fashioned" instruction (Carnegie Commission on Higher Education 1972), reaching new students outside the regular educational system (like working adults, and homebounds) to increase the equality of educational opportunities (Forman and Richardson 1977, La Buda 1978).

But soon the aspect of replacing was substituted by the aspect of adding educational opportunities, the major improvements being an increased enrichment of students and access to universities formerly outside the traditional educational system. Of course, one of these groups was the adult learner. For example, telecourses for national distribution were produced for this target group by the Coastline Community College, the Dallas County Colleges, The University of MidAmerica, the MiamiDade County

College, the Wayne State University, and the University of Maryland (Wiesner 1983).

Referring to Cross' (1981) ChainofResponse (COR) Model for understanding participation in adult learning activities televised (broadcast or narrowcast) instruction may influence the information about, the opportunities, and barriers for education. Via these new technologies and the services associated with them, educational programmes can be brought into the living room of the elderly, and this room may become a classroom. Also, if the educational programme is stored on video cassettes by the learners or the educational institution, the learners themselves can fix their individual learning speed. In sum with televised instruction, especially narrowcasting, a new delivery system for adult education is installed which may reduce the barriers and increase the opportunities; thus contributing to an increase in participation.

Another aspect is that progress in electronically storing and transmitting instruction may increase the likelihood of designing instruction according to the different learning prerequisites (Gagne 1977) of the older adult learners. This might be one reason that the arguments used for promoting programmemed instruction in the sixties are now entering again the discussion about telecommunication. For example, Kronbluh (1984) argues in favour of programmemed instruction for the following reasons:

1) Selfpacing. Time to process and comprehend information is up to the speed of the individual learner without inconveniencing other persons and without losing the connection with the televised information.
2) Little embarrassment. Mistakes are made in complete privacy: only the computer recognizes them.
3) Immediate feedback. Feedback is immediately available in response to learners.
4) Objective evaluation. Objective evaluation is made solely on performance of the learner without considering the personal characteristics.
5) Drill and practice. The computer never gets tired.

The aspects of delivery system and instructional design have to be realized on the background of the actual participation of the elderly in adult education, their educational opportunities as retired and the actual shifting to the information society. Even if participation of the elderly in educational programmes increased slightly from 4.5 percent of the age group 55 and over in 1978 (National Center for Education Statistics 1980) to 5.3 percent in 1981 (Grand and Snyder 1983/84, 156), the portions are still far beyond being representative. In addition, this share is only about a third compared with the share of younger groups involved in this type of education. Most adult education is now run by the private sector or the industry (Willis 1985, 825). Thus, the retired elderly have little chance of receiving on the job training. As we are shifting from an industrial to a postindustrial or information society there is an increasing social obligation to educate these elderly by using all available channels for disseminating education in general, and about these new services and potentials in particular. However, this education does not mean perfect accommodation to the changes of an information society. Another even more valuable aspect of this issue is that the educated become active participants in these advances "to ensure the continuing development of new technologies capable of meeting their evolving needs" (Jones 1983, 155).

4. Risks

In the preceding paragraphs an optimistic picture about the future of the elderly was drawn. However, this is only one side of the picture. The information society is a literacy-intensive society. Basic reading and writing skills are needed more than ever before (Naisbitt 1982, 11). This has to be realised on the background of the recent report 'A Nation at Risk' (1983). Besides other indicators of risk the following ones are recorded:
"Some 23 million American adults are functionally illiterate by the simplest tests of everyday reading, writing, and comprehension.
About 13 percent of all 17year olds in the United States can be considered functionally illiterate. Functional illiteracy among minority youth may run as high as 40 percent" (A Nation at Risk 1983, 8).
This means that there is also a danger that not all members of society may participate in the progress and advantages of the information technology for the daily independent life. Considering that professional knowledge is necessary to master the information overload and to get access to the resources principally available via terminals and screens at home, the assumption is that only a small proportion of the elderly (those well educated and/or self-instructed during the lifelong learning process) might gain the increasing benefits and access to the potential merits of the information technology. They might far better satisfy their coping, expressive, contributive, influential, and transcendence needs (McClusky 1971). On the other hand, probably this will not occur for the greater part of the elderly. Therefore, the likelihood will increase of dividing society as well as the subgroup of the elderly into a small group of benefitarians and a majority

of citizens excluded from the benefits of these innovations (see also Baldwin and McVoy 1983, 356; Elton and Carey 1983, 166).

The assumption that "hightech leads to hightouch" (Naisbitt 1982) can be verified with many convincing examples, but the opposite is also possible. This is confirmed by self reports of the target group. The majority complains that machines make life too impersonal, and half of them are confused and bothered by using the products of the information technology (Kerschner and Chelsvig Hart, 1984). The advantages may meet the wants and needs of a certain subgroup of the elderly. For example, for the homebound and other persons with restricted mobility these innovations can contribute to a more independent life style in a familiar environment. However, the majority still likes to go shopping and banking without telecommunication because these are sources of facetoface contacts.

Other questions concern the amount of time spent watching television. Will the amount of television consumption with the function of entertainment increase because of the time saved due to activities which can be realized now via twoway cable telecommunication? Will hightech perhaps lead only to vicarious (Bandura 1977) hightouch, to more isolation, and to an increasing ghettoization of certain subgroups of the elderly? This question cannot yet be answered (see Bengtson 1984; Black and Bengtson 1977), but there are some indicators that certain subgroups of heavy television watchers will increase their television consumption (Nielson 1984; Agostino 1980, 361).

In implementing and using telecommunication and its services an important criterion is the economic costbenefitratio. The dramatic falling off of prices for hardware is not equal to the price for the software. On the contrary, the production costs for software are still high. The price for professional work is more likely to increase instead of decreasing. For an entrepreneur, this means that the risk for return of investment is high, especially when the markets become increasingly smaller due to differentiation (Toffler 1980).

There is still a lack of appropriate software for these new technologies (see Baldwin and McVoy 1983, 87). Jones (1983) reviews three public nonprofit experiments (WETATV, Online Computer Library Center, Green Thumb) and four commercial operations (Knight Rider, Times Mirror, Warner Amex Cable Communications Company , The Source and CompuServe) with videotext, teletext, and home computer systems.
"Their offerings vary between specialized information; a mixture

of information, message, and transactional services; and entertainment" (Jones 1983, 147), with limited interactivity. The actual software is far away ladling out the possibilities of these technologies in order to create applications and services unimagined now, but which will characterize the third wave communication (Naisbitt 1982, 21; Toffler 1980). Jones (1983, 153) concludes: "technically and economically these problems are on their way to solution. The real problem is to identify and recognize the information needs of citizens today and to develop the software to meet these needs."

Baldwin and McVoy (1983, 4, 100) point out "that cable companies are promising services beyond tested technical capabilities at the time of application" in order to get the franchise. Who will feed the 24 public access channels, i.e. produce material for 576 daily hours of channel time available? Will the gap between professional and "home made" television programming (Rosenmayr 1983) facilitate or hinder the feeding of these channels? PACE and READING are still the two most often mentioned examples of the successful use of the new telecommunication technology for and by the elderly. A later example is "Life at the Top", a public access cable television programme for elders in Memphis, Tenn. (Winter 1985). But are they representative? Can these experiences be transferred to the elderly in general? Will the private sector develop services and programmes for the needs and wants of the common citizen in general and for the elderly in special? There are some doubts (see Jones1981, pp. 49). Thus, it seems that there are some dark clouds rising over the horizons of "Third Wave" telecommunication already.

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HOW WISE WAS W.I.S.E.? THE RESPONSE OF GIRLS AND WOMEN TO TECHNOLOGICAL STUDIES.

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Technological progress is admirable: but it may have unhappy effects on the careers and employment of women. In industry women workers are likely to be disadvantaged by such progress because they are largely occupied in relatively unskilled work which can most readily be taken over by technological devices: even in a 'white collar' occupation like banking women in many European countries are employed at the lower levels where, precisely, technological improvements may make their work redundant.(1) Further, women are less likely than men to engage in the scientific and technical studies which would prepare them to work in occupations where such a foundation is increasingly important. Thus it could be argued that one of the effects of progress in technology is to worsen the chances of women in the employment market.

This is a problem which has been widely recognised. For years now there have been proclamations in various countries of the need to further women's progress in employment and especially to encourage the greater participation of girls and women in the study of the physical sciences and technology. European Ministers of Education have frequently referred to such needs for improvement. The report (2) on activities of the Commission of the European Communities for 1983 and 1984 notes the work of the European Centre for the Development of Vocational Training in stimulating national programmes to provide training which will increase the range of occupational choices for girls and women. In the Commission's report (3) on Social Developments for the year 1984 there are references to such developments in a number of countries: e.g. in Greece, programmes "devised to initiate women in jobs traditionally reserved for men", in the Netherlands, an inclusion in policy plans to "encourage girls to take training courses that have traditionally been a male reserve" and in the Federal Republic of Germany measures both "at Federal and at Land level ... to train girls for technico-industrial occupations." What we have to consider now is the extent to which such efforts may be successful and to note those factors which are likely to inhibit the access of females to technological and vocational studies and to 'non-traditional' occupations for women.

Sex bias in choice of subjects, with male opting much more often than females for physical sciences, craft and technological studies at school, further education and higher education levels, is so widespread that it seems scarcely worth while to quote the statistics from various countries. At an international level the three GASAT (girls and Science and Technology) conferences which have taken place recently (Eindhoven, 1981, Oslo, 1983, London, 1985) have amply shown the concern common to many countries to induce more girls to engage in science and technology, the success of some efforts and the opposing factors in other cases. If we look at the UK situation, we note that in Scotland the examination figures (4) for 1984 are fairly typical: at Higher Grade Level (senior secondary school qualification) we find:

	Male candidates	Female candidates
Physics	9578	3309
Craft and Design	63	3
Technical Drawing	2769	104
Engineering	545	21
Navigation	14	0

In England, if we look especially at the situation in the Computer Studies examination at 0 level (Joint Matriculation Board, 1984) (5), we find 15636 male candidates and 7,153 females: at Advanced level, 1009 males and 236 females. In further education courses, figures for 1979-80 (6) showed the percentages of women students in various subjects and types of course as these:

	Full-time	Sandwich	Block-release	Part-time	In all
Phys. sciences	12.8	10.3	5.6	9.5	10.5
Chemical sciences	21.1	24.0	0.0	23.0	22.5
General Engineering	2.7	7.7	0.0	1.8	2.1
Electrical Engineering	2.1	1.1	1.9	0.4	0.9
Maths and	26.3	21.8	14.3	23.0	23.6

	Full-time	Sandwich	Block-release	Part-time	In all
Computing					
Civil and Constr.	1.4	1.7	0.3	2.0	1.7
Engineering Craft trades	0.4	0.0	0.4	0.2	0.2

From this last table we may immediately recognise - in addition to the low level of participation of females in block release courses especially (a responsibility of employers?) - one probable difficulty confronting the young female trainee in certain fields of study: she may well feel lonely, lacking the support of female fellow-students.

The Computer Studies Situation is one which has particularly attracted attention recently and a good deal of comment has been made on the possible reasons for the lesser participation of females here. One survey by a manufacturer (Acorn) noted that where families had a home computer it was in only 17% of cases that the mother made use of it: this would seem to be a case of a negative role model for daughters. Outside school also, it has been argued, computer games tend to be of the Star-wars type - or provide other agressively motivated situations - which may be more likely to appeal to boys than to girls. In school, some have suggested, in classroom work girls may be elbowed out of the way by boys more confident in their ability to cope with the computer. Yet there is also evidence that girls and women can be very successful in computer studies. A recent American survey (7) has indicated that girls in high school can perform rather better than boys in some aspects of computer programming. And tutors in at least one British university conversion course for mastership in Computer Studies have noted how successful women students can be, even those whose earlier studies were in the Arts field and did not include an advanced level of mathematics.

What we have then is awareness of a problem and of difficulties in attempting to solve it. An instance of another discrepancy between intentions and results can be found in the TVEI (Technical and Vocational Education Initiative) scheme in England where from the outset it has been stated that sex bias in provision of courses must be avoided. Yet in some schools it can be found that boys but not girls are invited or urged by teachers to attend talks explaining the characteristics of the courses offered in the local Technical College as part of the TVEI provision: teachers take it for granted that girls will not be interested in a technical course and tutors in the College may share this attitude: likewise when the school timetable is being adjusted to allow for attendance in the local college it may prove to be rearranged on the supposition that it is only boys who will be in the college for certain periods and must therefore have supplementary school classes arranged. Similarly the YTS (Youth Training Scheme) may show bias in its working. The Further Education Unit has noted (8), e.g., that at an information technology centre the proportion of girls to boys attending under the YTS scheme was 1 to 5. Girls are less often than boys employed on YTS Mode B (industrial board) courses.

What attempts are being made to improve the participation of females in the scientific and technical areas? Internationally, we have noted the GASAT conferences. In the UK 1984 was WISE year - the year of Women into Science and Engineering - when various conferences were arranged, publicity about female participation in such areas was provided by talks from women who could serve as examples of successful workers in science and engineering. Yet it remains uncertain whether the year was a success, though some enthusiastic responses were evoked and good publicity achieved. Supporters question whether the situation has in fact changed or modified. Similarly at the specific level of the secondary school there has also been the GIST (Girls into Science and Technology) (9) project carried out by a team in Manchester (1979-84) which focused on a cohort of pupils in ten schools and studied by action research (in eight schools, using two schools as control groups) ways by which girls might be more greatly involved in science studies. Again the results seem inconclusive. Some slight increase in the numbers of girls to study physical sciences may have resulted, and increased sensitivity to the problem was produced. But the researchers indicate finally the overwhelming influence of other factors determining the girls' choices - the views of parents, primary schools, peer groups, employers.

From these and other studies we return repeatedly to the awareness that whatever short-term action may be taken there is the problem of attitudes closely intertwined with the problem of education to prepare for various employments in a technological age. Such attitudes need to be defined.

Insight into such attitudes may come from the study of direct attempts to tackle the problem at the post-school level. In Britain the Engineering Training Board initiated in 1976 a Girl Technician

Scholarship scheme which attempted to show all those concerned - parents, girls, employers - how successful girls could be in this field of work. Later the Board has provided special grants for employers who recruit girls as technicians and technician engineers. There have been created in different parts of England various refresher courses and other courses (mainly short-term) for training women in technical studies, though one doubts whether the provisions made here are comparable with those in West Germany (10), where special courses (sometimes 3 to 3,5 years in length) have been provided for females to train as technicians or courses of rather lesser duration have been provided for slightly older women -e.g. in Hanover provisions for women to train for non-traditional craft and skilled work; in North-Rhine Westphalia, similar courses for skilled work in occupations non-traditional for women; in Essen, courses to upgrade unskilled women workers to achieve qualification as skilled workers.

Such developments have the advantage of attacking the problem at a level where, it is argued, intervention may be more important than intervention in higher education. Certainly in higher education attempts have been and are being made to recruit more women students to study technology in universities and parallel institutions. Various Faculties of Applied Sciences in British universities have organised talks for Sixth Form Pupils in schools, or day conferences or longer visits to the universities, so that girls can see what engineering studies involve and be assured of a welcome if they decide to choose preparation for a career in this area. Possibly such efforts are the cause of the increase in the percentage of women students in Engineering and Technology in British universities (11): it is now 9.7% which - though not spectacularly great in comparison with the level in other countries - is a considerable improvement on the proportion found only a few years earlier. Yet it is argued - and this argument was voiced especially with regard to efforts made during WISE year to present to audiences of schoolgirls women who had made an outstanding success in non-traditional careers - recruiting at the higher levels may not materially alter the situation. Exceptional women can indeed flourish there and perhaps serve as outstanding examples; but it is not until there is steady recruitment of female employees in technically based subjects at the 16+ age level that a real change will have been effected.

What then do we learn from the attempts to encourage young women to enter into non-traditional studies and occupations? What factors and attitudes are important in reducing the effects of well-meant endeavours to orient girls towards science and technology?

Firstly, there are the attitudes still found among school pupils by which some subjects are regarded as 'boys' subjects', appealing more to boys, and some regarded as 'girls' subjects'. Traditionally the boys'subjects have been maths, physical sciences and crafts/technical subjects. Happily there is evidence to show some changes in these attitudes: mathematics is now thought of as a subject which 'belongs' to both sexes (even if there remain differences between sexes in their competence in different types of maths work and in their confidence in tackling maths). Biology is becoming less typecast as a girls' subject: even chemistry is moving towards a bi-sexual rating. But it still remains true that physics, building studies, metalwork, carpentry, CDT (Craft Design Technology) are not likely to be rated as girls' subjects and home economics/home sciences/office skills are not likely to be thought of as boys' subjects (even if office skills now demand competence at least with word processors). Although the English school system still allows pupils to opt for subjects with such stereotypes in mind - and allows teachers to counsel pupils in accordance with such stereotypes (to suggest, for example, to a boy that typing is not a good choice for him)- there are pupils who do make 'cross-sex' choices and study of their attitudes can be illuminating. It would appear that when girls make such a choice they are more likely to give as their reason that the subject is interesting or challenging and possibly may have some future usefulness in their homes. Their cross-sex choices seem seldom to be made on the basis of career prospects or the wish to enter a non-traditional occupation. Boys, on the other hand, in making a cross-sex choice are often likely to do so with an eye to future career prospects: e.g., to opt for home economics with a view to a career in catering.

A factor which does seem to encourage girls to opt for a 'male' subject or for a male occupation is apparently the influence of a male relation - father or brother or uncle - who has shown the appeal of the subject and encouraged the girl's interest in it. (Given the sex-stereotyping of subjects and occupations it is only in exceptional cases that one would expect the mother to foster such interests). Teachers seem less likely to be influential in this respect: possibly because all too often the teachers accustomed to teaching one sex group are not ready to welcome or encourage 'interlopers' - they may find them somewhat disconcerting. But an interesting attempt has been made recently to introduce a new kind of 'model' for school girls. This can be found in a recent publication (12) of the Equal Opportunities Commission, Letters to a Thirteen-Year-Old. Intended for the young girl of this age, moving towards choosing her options in the secondary school, these letters are from girl apprentices in non-traditional occupations - e.g. electronics, electrical engineering. In each a young woman apprentice describes briefly and candidly her entry into her occupation and her training in it as well as her reactions to this training. Photos and a line or two in the handwriting of the women apprentices add a personal and interesting quality to the booklet. It remains to be seen whether such models will be accepted and have the intended effects.

The factor of encouragement and modelling from men in the family circle has also been evident in results of researches dealing with young women in the 16+ age group. for instance, an NFER study (13) based on interviews with young women attending science or technical courses in Further Education institutions found the part played by family connections to be important in having determined an early interest in a science or technical subject and having strengthened the young woman's determination to follow the career associated with the subject. Thus women students on a building and construction course had decided for it "in their mid teens when, with the help of this relative, they had explored the possibility of careers in construction" (14). Likewise, a study carried out for the YWCA (15), interviewing young women who were apprentices in 'male' occupations, noted that for them also family examples had frequently been influential in determining their present occupation. (One recognises here that family connections may also be helpful in actually finding a post for the 'divergent' young person.)

But although in such cases the influence of the male relative has been positive we cannot judge how many young women have been strongly counselled or warned by male relatives against thinking of an occupation which is traditionally for men. There is some evidence of schoolgirls reporting that at home fathers especially expect them to live up to the stereotyped 'feminine' image, which is incompatible with an occupation where workers get dirty. It would seem difficult to ensure that the factor of family encouragement will support girls' more divergent choices though just possibly school contacts with parents could gradually break down family prejudices against some occupations as 'unwomanly'. It is also an interesting point - since prejudices about women's appearance have been mentioned - whether educational attempts to encourage recruitment to science and technology by bringing in women speakers who are in a male occupation but dress in a charmingly feminine fashion (and who mention that they are also wives and mothers) are effective and legitimate: they do reinforce some stereotypes, even in the attempt to break down others. And there is indeed the further aspect of this problem for the woman worker in a non-traditional occupation. Should the young woman engineer appear on a building site dressed in a pink trouser-suit? Or should she adopt the camouflage of the customary male attire for such occasions?

Let us further consider the factors and attitudes resulting from interaction with the working group. Where girls are in training for a non-traditional occupation, we find two types of reaction to their minority situation. Some report happily that all is going well. For example (16), two girls learning to be motor mechanics on the YTS scheme reported that as two girls among 38 boys on the course they had been "very well accepted by the boys". Yet this kind of expression of satisfaction does seem to indicate the underlying expectation that the boys might not have accepted them very well. There is, in such accounts, an underlying supposition that it is particularly good of the boys to receive girls apprentices kindly: the boys are seen as having a right to be there, the girls, perhaps, seen as being there on sufferance. In the other case, the explicit reaction of the girls may be less happy. Some, for example, among those interviewed in the YWCA sample, mentioned initial difficulties in being accepted as one of the apprentices' group even if, after varying periods of time, they managed to negotiate a satisfactory relationship. It was evident from these reports that the 'settling-in' period can be particularly difficult for these young women precisely because they may be in a minority of one. In such circumstances they may think that the problem is a matter of their own personality and abilities - not a more generalised expression of conventional prejudices of a relatively impersonal kind (prejudices dissipated as the individual comes to be known as herself). In such cases, the possibility of exchanging views and experiences by meeting with other female apprentices who are also working in isolated situations is found to be appreciated by the individual. The YWCA project has in fact led to setting up the GETWISE network by which such support can be provided to young women entering non-traditional occupations.

Some important attitudes must be noted as affecting the actual work performance of the young apprentices. Again, young women have been found to differ in the confidence with which they approach the practical side of their work. Some who have been accustomed to 'tinkering' with machinery from an early age approach the practical tasks with confidence equal to that of their male fellow-learners. Other young women have admitted to an initial lack of confidence in dealing with machinery. And research in Britain and America on pupils' practical work in science labs in schools has pointed to similar differences in the amount of confidence with which boys and girls tend to approach tasks requiring them to cope with what may be fairly simple gadgets or instruments. Girls, it has been pointed out (17), are less likely to have played with mechanical toys or to have picked up in home surroundings facility in effecting minor household repairs: thus in the school laboratory they do often approach some instruments with the feeling of insecurity which results from lack of experience. There would seem clearly to be a need for schools to recognise this possible difference in background experience and deal with it by giving girls the necessary practice and guidance in handling instruments or machines. But it is also noted that at the apprentice stage, in the practical work situation, there may be a greater willingness of skilled or experienced workers to help and guide the female apprentice precisely because she is not expected to be as experienced as the male learners in fairly routine mechanical tasks. The young woman's reaction will depend partly on her actual level of confidence and skill: but in any case the avuncular attitude is not wholly without defects from the point of view of young women.

Motivation is also clearly an important part of the effective situation. Here a wide range of studies suggests that when females do enter on non-traditional areas of work they are highly motivated and learn well. The West German researches seem to agree with the NFER and YWCA studies on this point. The young women adapt successfully to their work situation and the working group.

We have seen therefore various factors and attitudes likely to affect the policy of recruiting more girls and young women for preparation for occupations based on scientific and technical studies. Some of these might well be changed by educational agencies, by changes in the behaviours of school authorities and teachers - though the family background remains important and often difficult to change. What remains to be studied also is the employment situation of such young women as do enter the non-traditional occupations: what is their fate when their training has been completed and even after the first few years at work? Some obviously succeed in making a success in their chosen occupation. But how many find themselves moving, once qualified, back to the type of job traditionally thought of as suitable for women? To personnel work in the factory? To employment as school technicians rather than in industrial concerns? (And there was recently the interesting case of the female who was refused employment in a submarine, however appropriate her qualifications were.) To what extent does the success of the female apprentices employed during an experimental period lead employers to increase the proportion of female entrants? Do employers remain content with a 'token' gesture of continuing to admit a small minority? Some of the young women apprentices studied have complained that on occasion they feel themselves to be simply a 'show piece' used to demonstrate to visitors or researchers the employer's progressive outlook: they feel they scarcely have the chance to settle as 'ordinary' workers. In the YWCA research too, when questionnaires asking about the employment of girls as apprentices were sent out to employers in two areas of England, the response rate was poor: and many of the responses that were received said that no girls were employed. It is of course possible that many of the non- respondents were employing girl apprentices: but it seems on the whole improbable. And while one recognises that questionnaires (even very short and simple questionnaires) sent out by research workers can be irritating, it may also be the case that many non-responding employers did not feel that the subject of girls apprentices was worth considering. Certainly interview evidence indicated that for girls entering the non-traditional areas of work having a 'patron' who supported this entry was helpful. So clearly much does depend on the attitudes of employers and so far as can be judged, there are still many employers whose attitudes are not symphathetic to the recruitment of women to work requiring, especially, technical or technological competence.

Hence we come to yet another important attitude - the judgment made by young women of the possible availability of employment if they do venture into the new territory. Given the present difficulties in finding work in many West European countries, many young women may judge - and judge rationally - that their prospects are better if they stick to the traditional areas of employment for females. Careers teachers in schools in Britain, recognising in their contacts with employers the amount of prejudice still militating against female workers in certain industries and crafts, may feel that they must warn the young woman embarking on non-traditional occupation that she may encounter considerable difficulties on her way. (It is of course also true that in Britain the service occupations employ a larger proportion of the working population - more, for instance, than manufacturing. And there is also to be considered the crafts and technologies which are obsolescent: there would need to be very careful consideration before recruiting a new body of workers to such areas.)

Over all, we can see that there are still important factors which lessen the likelihood of major changes in the numbers of females opting for certain scientific, technical or technological studies and occupations. Schools can do something to show the attractions of these subjects and make them welcoming to both sexes. They can build up girls' confidence in their abilities to use new techniques and machines or gadgetry. Liberal employers can foresee the possible difficulties which female workers may encounter and can do something to reduce these. But the simple matter of finding employment at all still looms large. There is, in more than one country, evidence of trained young workers, females qualified in technical skills, finding themselves apparently unemployable. (Of course, there are also skilled young men in this situation: but - unless they seek refuge in domesticity - young women do seem to have greater problems.) The question thus remains whether the employment market is ready to cultivate equally the skills and working abilities of women as technology changes the work place and our way of life. The recent announcement of reduction in availability of the European Commission's Social Fund (19) and the setting of priorities for assistance to projects in different countries and regions should be ominous. The need to further the employment of women is still noted as a priority: but the major problem of unemployment might well reduce support for the special provisions which till now were encouraged to recruit women into new skills training. Does the technological society of Western Europe really want more technically qualified women workers?

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NEW INFORMATION TECHNOLOGIES AND THE CURRICULUM ANALYSIS OF THE CURRENT SITUATION IN PRIMARY EDUCATION WITH INDICATIONS FOR FUTURE DEVELOPMENTS. THE FLEMISH SITUATION

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Introduction

Confronting the actual use of the new information technologies (N.I.T.) in primary schools with the potential relevance of this new medium, a lot of shortcomings come to light. In this text we outline a theoretical framework in relation to the potential use of N.I.T. in primary education. Next, we give a short description and analysis of the situation - focusing on the Flemish part of Belgium. Thirdly we compare the theoretical potentialities with the situation and gather indications for future developments.

The potential use of computers in primary education. The integral approach

In coordinating many initiatives and projects in primary education in Flanders EDIF (Education InFormation Sciences) tries to promote the integration of N.I.T. in the curriculum of the primary school. This integration is really of prime importance since lots of computer-projects fail, have no impact on the broader educational field or do not affect profoundly current teaching and learning practice. Computer use stays- in many cases - an isolated activity, not linked to or responding to real needs of educationists. A very good example of this kind of less successful approaches is a current computer project. Project members come to schools and explain the use of one type of machine and demonstrate about 14 software packages (1). This computer, the software and an introduction booklet can be used (free) in the school for three months. The project team expects this kind of approach to spread computer use and to improve of the software. The project is - in quantitative terms - successful; a lot of schools want to use the materials with the children for a certain period. But only very few schools do buy a computer after the initial experiences with the children or feel more motivated to do so. This project reflects - like so many other initial experiences - a restricted view on computer use, because of the limited amount of software packages and, consequently, the very limited (and questionable) set of objectives which are pursued. Moreover the computer activities are not embedded in the normal, curriculum activities and the use of the computer as a 'tool' is left - to a greater or less extent - to the teachers.

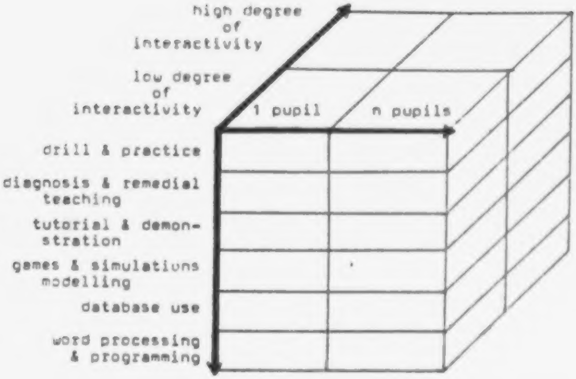
A profound evaluation and reorientation of a lot of educational computing projects could be sustained, if a structured survey of existing computer use should exist. Especially a hierarchical classification could e.g. be helpful.
Such a classification could show what kind of computer use dominates the field in quantitative terms and the inherent restricted or promising potential of each type of computer use. But many surveys or classifications of computer use in education, neglect the clear interrelation between computer use and the curriculum. The classification dimensions used are not always that relevant to give indications about the value of the computer use. We copy some of these classifications, to enlighten this point:

- Application programme
- Simulation "
- Drill and Practice
- Tutorial
- Computer Modeling (2)

- Tutorial programmes
- Simulation
- Games
- Problem solving
- Creative activities (3)

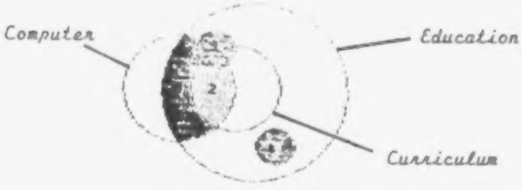
These classifications take as a classification dimension or criterion the analogy between e.g. the software used and the teaching-learning methods, reflected in the specific packages.
But other classification dimensions are possible. We can e.g. look whether the package or computer facility is to be used individually, with groups or with an entire class. We can check whether the computer application extends, consolidates or enriches the curriculum. We can look at the behavioral level of the pupil activities induced by the computer programme. We can classify the program according to the level of interactivity built-in. These classification dimensions can help teachers to 'integrate' the software packages in their current practice.

This way of classifying educational programmes results in a multi-dimensional model about the educational potential of computer use in the primary school.
The picture on this page is an example of such a model (4)
This classification model can be considered as a first step in outlining the interrelation between computer use and the curriculum. But other dimensions can be helpful to describe the use of


high degree of interactivity
low degree of interactivity
1 pupil
n pupils
drill & practice
diagnosis & remedial teaching
tutorial & demonstration
games & simulations modelling
database use
word processing & programming

This classification model can be considered as a first step in outlining the interrelation between computer use and the curriculum. But still other dimensions can be helpful to describe the use of NIT and permit in this way a more fluent integration in the curriculum. The following model indi-

NIT and in this way permit a more fluent integration in the curriculum. E.g. the following model indicates the possible quantitative effect of computer use on the existing curriculum:


Computer
Education
Curriculum
2
4

The computer and the educational world are presented as 'sets'. The curriculum is a subset of the set education. Subset 1 points out an extension of the curriculum. Generally this extension is called 'computer literacy'. The impact of computers on society implies mastering new skills, knowing new concepts, facts,... Number 2 outlines a consolidation of the existing curriculum. Most software packages, e.g. drill and practice, simply help to pursue objectives, clearly indicated in the curriculum. Number 3 does not extend or consolidate the curriculum, but helps to enlighten aims and objectives which are not explicitely found in the subject-oriented curricula. In this field we find e.g. objectives in relation to the acquisition of problem solving skills, productive thinking, communication skills,...

The more we direct our attention to domain 2, the more the computer application is bound to certain 'contents' (subject matter). The more we direct our attention to domain 3, the more the software package is content-free. Consequently, we find in domain 3 e.g. programming environments like Logo, Word processors, the development of relational data-bases with Prolog, playing with small expert systems like Conniver, Penelope, ... Here, the specific content is variable and in many situations chosen by the pupils.

Another classification of computer applications can give indications about the 'content' of the objectives which are pursued. These contents can be classified in a hierarchical way (5): Is the computer application helping the pupil to acquire facts or getting insight in concepts, relations?Is the computer application directed towards the acquisition of skills or the training of attitudes?

Another curriculum-bound classification looks at the behavioral level expected of the pupil when working with the software. Does the computer application imply drilling a certain algorythm, repeating certain facts, getting insight in a certain rule, deducing certain rules or applying the relation between concepts, manipulating a complex conceptual structure,... Authors like Bloom, Kratwohl, De Block, ... give examples of such taxonomies in which the expected behaviour of the pupil is hierarchically structured. Putting these dimensions together in a 'model', we get the following picture: (see page 365)

Although classifying software and computer applications is criticized by some authors, it is the only way to get some indications about the quality or shortcomings of the existing amount of material.

The picture we can get by looking at software in this way, can help us, first of all, to give directions for future software development and, secondly - and this is the most important outcome - to state clearly where and when and to what extent a certain package can get integrated in the curriculum. Only when we know exactly what concepts or relations are pursued, what kind of behaviour is expected, ... we can check more easily the relevance of a certain kind of computer use for our situation.

Computer use in primary education
The situation in Flanders

1. The official point of view

February 1985, the Education Department launched a five year-project in relation to the introduction of N.I.T. in Flemish schools. Although special commissions were established - one of them concentrating its activities on 'N.I.T. as a medium for primary education'- no concrete initiatives are planned to structure, coordinate, plan or sustain computer use in primary education, so far as we know. Full priority has been given to the integration of the new media in secondary and higher education (6). This sounds strange, since a lot of things are going on at the primary level and there is a great demand for coordination. This situation can even have a very negative effect on future developments: first of all there is the overall pressure of educational authorities in relation to computer use in schools and, secondly, a lot of initiatives fail and consequently provoke negative attitudes to the N.I.T.

2. Education pressurised - Hardware problems

Many authors have already given a survey of the instances, influencing or exerting pressure on education (7). In the Belgian situation, a lot of initiatives are e.g. sponsored by private banking - houses or saving banks. This is comparable with the situation in the Netherlands. As a consequence of this evolution, uncoordinated projects are set up, with or without approval of the government, with or without control of education authorities (e.g. inspectors). This causes, for instance, the presence of a variety of computers in the educational field. The selection of this hardware has not been made on educational grounds. On the contrary, socio-economical reasons affect this kind of decisions. The British example clearly illustrates this problem. But the British government has given at least 'some' indications about what kind of machine was eligible for State-aid in schools. Leaving the choice of the hardware to external instances, this can have a tremendous effect on the hardware diversity. A very recent analysis of the situation in the primary schools in the

Netherlands reveals e.g. the presence of about 17 types of computers (8). Two types dominate the field. The question is whether there is relevant software exists for these types of computers. Actually, no information is available in relation to the Flemish situation. In ordert to gather this kind of information, a questionnaire was sent to about 100 primary schools. These schools all belong to two districts of the Official Inspectorate (9); the districts are randomly selected among 8 districts. 83% of the schools responded to the questionnaire. 31% possess a computer; 29% will possess a computer within some months. This means that about 60% of the schools use or will use a computer in the very near future. A remarkable fact is that 68% of the computers in these schools are of the same type! This is the outcome of a large-scale project of a savings - bank. Looking at the educational use of the computers, in these primary schools, only 8% of the schools do actually use the computer as a tool for learning! This is partly due to the fact that for the type of computer dominating the field, hardly any educational software has yet been developed. The only programmes, delivered with this computer are introduction programmes, an author language for educational application and - and this is maybe the most promising package - a Logo-version.

3. The software problem

The results of the questionnaire, outlined above, illustrate one of the main problems in the field of computers and education. The purchase of the computer precedes the reflection on the future educational use of the medium. Schools are not at all aware of the narrowing and restricting effect of this way of acting. Ennals writes the following about this problem: 'The computer should not be the focus of attention. We should return to thinking about education and training, the thinking that we wish to encourage, with the computer among our tools.' (10).

Nevertheless a lot of software in Dutch exists. Next to the fact that this software is not suited for most of the hardware, now present in the schools, another question is to be posed. What is the quality and what are the characteristics of the existing software?

Geoffrion (11) analyse 500 American commercial products for school use. He came to the significant conclusion that 77% of the language arts material was classified as note drills or skill practice lessons. Only three of the 105 language arts programs involved language units larger than individual words in setting other than drills.

Looking at a directory of programmes (12), commonly found in the

Flemish educational field, the following can be found: only 32 of 228 programmes (14%) are made for use in primary schools. 27 of these programmes are to be considered as 'drill and practice' programmes. 4 of the programmes are 'tutorials and/or demonstration'programmes. There is only 1 'simulation' among the 32 programmes. Of course, the use of computers in education cannot be restricted to software packages. Programming with Logo or Basic and the use of word processing packages can be found in some schools (only 2 schools in our questionnaire).

Putting things together
Indications for future developments

Confronting the situation with the potential use and value of computers in schools is not a very pleasing activity. It becomes clear that the most promising computer activities like programming, data base use, word processing, simulations and modelling, ... do hardly exist in the educational field today. Of course, there have been a lot of experiments; and, of course, such an educational innovation takes time; and, of course, at university departments or other research centres there is much interest and research in the most promising computer uses. But... looking at the 'facts', looking at the existing hardware, the existing software, there is not yet a sound base for developing a national policy or strategy in relation to the immediate introduction of computers in education. This does not mean a national policy or approach is impossible. On the contrary, a clear analysis of the problem shows immediate priorities in relation to teacher training, project coordination, research sustainment, providing computer facilities,...

Moreover, a lot of new trends appear in the Flemish situation. Logo, e.g. is now available on almost all the computers present in primary schools. At the State University of Ghent (EDIF), packages are being developed, in cooperation with primary school teachers and educationists to 'integrate' Logo activities in the curriculum. The curriculum is analysed, objectives are chosen, packages are constructed (indicating what,how and when), Logo material is being developed, packages are tested and consequently edited,... . There is also some research now in the field of expert systems for primary schools, word processing and data base use. A last promising new trend is the development of better and new kinds of educational software. Simulations, games,... get a lot of interest. We expect this development to persist. At the same time we hope that the 'educational' basis will be respected in order to benefit the 'integration' of computer use in education.

Notes

1) Nearly all the software packages are drill & practice programmes, some of them can also be used as tutorials and/ore demonstration programmes. Among them there is only one simulation. The project has been running since beginning 1984.
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3) Zinn K.L., A survey of current developments in Computer Assisted Learning in the United States, in: Programmed Learning and Educational Technology, 1978, 14, 2,p.126-135
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5) In this text we use the hierarchical classification of: De Block A., Algemene didactiek, 1975, Antwerpen, De Standaard Uitgeverij
6) For an introduction to the official point of view of the Ministry of Education (Flemish region), we refer to the following publications:
   Coens D., Computers en onderwijs, toespraak ter gelegenheid van de voorstelling van het referatenboek 'Onderwijs en Computer', Contactcentrum Bedrijfsleven en Onderwijs, Aalst, 1984
   Coens D., Beleidsvisie inzake nieuwe technologieen, slottoespraak ter gelegenheid van het colloquim 'Nieuwe Technologieen en Onderwijs', Flanders Technology International, Gent, 1985
   Coens D., Invoering van de informatika in het onderwijs - vijfjarenplan, Brussel, Ministerie van Onderwijs, 1985, 5pp.
7) We refer to the following authors: Rushby N. & James E.B. & Anderson J.S.A., A three-dimensional view of computer-based learning in continental Europe, in: Programmed Learning and Educatioonal Technology, 1978, 15, 2, p.152-161
   Valcke M., Computer-based learning systems at the elementary school - Psychopedagogical reorientation, in: Scientia Pedagogica Experimentalis, 1982, XIX, 1, p.130-143
8) This study has been carried out by software and hardware producing companies (Malmberg and Commodore) in 1985. 45% of the schools (=3781) responded. Only 707 schools did actually possess a computer. 686 indicated they will have a computer within the period of about one year. This brings the future (short term) amount of hardware, present in Dutch schools, up to 1393 (36,8%). 1012 schools (26,7%) explicitly indicated they do not want a computer yet. Two types of computers dominate the field; 633 of 707 (89,5%) computers belong to these two types.

9) In Belgium, several authorities are responsable for the organisation of education. Besides the official primary schools of the State, e.g. the Catholic Church (N.S.K.O.) also organizes primary education, subsidized by the government. In relation to the policy of the different education authorities with regard to the use of computers at this school level, there are not that many differences.

10 Ennals R., Future needs, in: The Times Educational Supplement, 25 March 1984, p.43

11 Geoffrion L., Computer-based approaches to language handicaps, in: World Yearbook of Education 1983 - Computers and Education, Megarry J. (ed.), 1983, London, Kogan Page, p.215-229

12 This survey includes commercial programmes and programmes available free from organisations (Ocober 1984).

Content Directed ⟶	⟶	*Content Free*
Consolidation of the curriculum ⟶	⟶	*Enrichment of the curriculum*
Knowing - Having insight in : ⟶	*Application of* ⟶	*Acquiring*
Facts *Concepts*	*Facts* *Concepts* *Relations* *Structures*	*Skills* *Attitudes*
Drill programs *Practice Programs* *Diagnostic programs* *Tutorial Programs* *Demonstration Programs* *Learning games*	*Demonstrations* *Simulations* *Games* *Modelling programs*	*Programming* *Data-base use and development* *Word processors* *Expert systems*

COMPUTER-ASSISTED PROGRAMMED CASES: A LEARNING METHOD FOR IMPROVING THE UNDERSTANDING OF PERSONS

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Abstract

In several professions (e.g. psychologists, educationalists, members of the police force, nurses, forensic experts, a.o.), it is part of the job to be a person with high psychological and interpersonal skills: one has to have an accurate interpersonal perception and a high degree of psychological insight. Assessing the accuracy of psychological insight and interpersonal perception is since long a troublesome area in psychology. The same holds for what concerns the training of such skills.

This paper addresses the presentation of a technique suitable to assess and train persons in their ability to have 'insight' in the behaviour of other persons. If used in a computerized way, this technique could be an assessment and training-tool used in order to teach how to judge other persons. An improvement in the 'psychological insight' skills could probably result in a better performance of such professionals as named above.

This paper has the following four aims:

1. Presenting Programmed Cases, a method developed by J.P. De Waele with the purposes of improving one's ability to predict behaviour and increasing one's understanding of other people. Programmed Cases can be defined as an application of methods of programmed instruction to the study of single cases (life histories). Essential features of this method and the construction of programmed biographies are discussed.
2. Demonstrating the possibilities of on-line computer administering of Programmed Cases (by means of the IMG system (IBM) running on a mainframe computer). The advantages of Computerized Programmed Cases compared to paper and pencil administering are discussed.
3. It is argued that (Computerized) Programmed Cases can be used as a training method for clinical psychologists and other social scientists.

A current research programme is presented in which the effectiveness of Programmed Cases as an educational tool is evaluated.
4. Finally, it is shown that Programmed Cases can be used as a powerful research instrument for studying psychological assessment, person perception and person judgment.

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In several professions (i.e. psychologists, educationalists, forensic experts, members of the police force; nurses and others) it is part of the job to be a person with high psychological and interpersonal skills: one has to have an accurate interpersonal perception and a high degree of psychological insight.
Assessing the accuracy of psychological insight and interpersonal perception has been a troublesome area in psychology for a long time. The same holds for the training of such skills.

All the processes that play a role in 'getting to know a person' such as person impression, person perception, image-building, person judgment, prediction and person description can be encompassed by the term 'psychological insight'.
Psychological insight refers to the individual's ability to understand the personal characteristics and motivational processes of people (Greenspan, 1981). A review of the literature based on computerresearch (1) revealed:

a) that there is no adequate and acceptable taxonomy available of the constructs 'social and psychological insight'. In other words a lack of conceptualisation.
b) that there are no adequate techniques to measure psychological insight. In other words a lack of operationalisation.

ad a) The concept of psychological insight has a broad and confusing variety of possible meanings. The only attempt known by me and therefore used is the taxonomy of social awareness by Greenspan (1981).

The term 'social awareness' may be defined as the individual's ability to understand people, social events and the processess involved in regulating social events. In the taxonomy of Greenspan social awareness (or social intelligence) is divided into three component abilities: (1) social sensitivity as the individual's ability to label accurately the meaning of a social object or event, at a given moment in time, (2) social insight as the individual's ability to understand the processes underlying social events and to make evaluative judgments about such events and (3) social communication as the individual's ability to understand how to intervene effectively in interpersonal situations and influence succesfully the behaviour of others. For a broader discussion of the abilities social sensitivity and social communication see Greenspan.

The second major component of awareness (social insight) is divided into three constructs: "social comprehension', 'psychological insight' and 'moral judgment'.
The term social comprehension refers to understanding of social institutions and processes. The term psychological insight refers to the understanding of people, how they differ from each other (person perception), and why they behave the way they do (person prediction). The term moral judgment refers to the ability to think about social rules and about ethical matters.

In all three of these constructs the emphasis is upon the ability to generalize about interpersonal behaviour and events, rather than the ability (as in social sensitivity) to phenomenologically respond to a concrete social event. Such concrete events can be used, however, in assessing social insight; it is just that the question being asked is different: instead of being asked to show a surface understanding of the event (what is happening?), the person is being asked: why is it happening and what is its significance in a broader scheme of things? For more details of these constructs see Greenspan, 1981.

ad (b) Operational definitions of 'psychological insight'. The main reason for the lack of an adequate operationalisation of 'psychological insight' is that most psychological insight tests don't deal wiht a 'genuine situation with real persons' (Thorndike, 1920, p. 231). Most psychological insight measures have been modelled after traditional tests (mostly intelligence tests) which are primarily composed of items that are abstract, decontextualized and have little or nothing to do with one's actual competence in real-life social situations. Studies in the accuracy of interpersonal perception used to set subjects the 'guess the quantity of a trait' task or the 'guess what he would write' task (Mc Henry, 1968). In the 'guess the quantity of a trait' task, subjects are given a list of personality traits and they are required to state the quantities in which these are possessed by certain stimulus persons. Often a comparison is then made between the subject's judgment and the stimulus person's view of himself. In the 'guess what he would write' task a stimulus person is required to fill in a personality inventory and it is the task of subjects after meeting him or seeing him on film to fill in the same personality tests as he thinks the stimulus person did. But these interpersonal judgments which as the subject one is asked to make in the laboratory are not similar to those is used to making in everyday life.

In complex problem tasks like the task 'getting to know and judge a person accurately' the actors are an active element in a complex network of active and passive elements (Dörner et.al., 1984).
The reality the actors act in is:
1) a complex one: there is a lot of information available,
2) intransparant: a lot of necessary information is not available,
3) self dynamic (eigendynamisch): the situation and the other persons are active and autonomous (selbstbewegend).

In recent cognitive psychology and problem solving psychology there has been some research on problems of a completely different kind: the problems are very simple, transparant and static (for instance the prisoner's dilemma). As a consequence most psychological research is totally inadequate for the analysis and the understanding of complex problems and especially complex social problems.

As Ford and Tisak (1983) clearly stated, a measurement approach is needed in which the behavioural effectiveness criterion for defining psychological insight is translated into precise, relevant and practical operationalizations of the construct which retain at least some of the richness and meaning of real-life social interactions. So what is needed in order to study psychological insight is a task that deals with the behavior of real persons who have a biography. In other words a 'what he would do' task. The technique of the programmed cases refers to such a task.

Not only assessing the accuracy of psychological insight has been a troublesome area in psychology for a long time, the same holds for the training of such skills.

1. Essential features of Programmed Cases.

Programmed Cases is a method constructed by Dailey (1971) and futher developed by J.P. De Waele (1971) with the purpose of improving one's ability to predict behaviour and increasing one's understanding of other people.
The method of Programmed Cases can be defined as an application of methods of programmed instruction to the study of single cases

(life histories). A Programmed Case is a life history of an individual divided into time-segments, called episodes. The case is presented to the subject one event or episode at a time, and the subject is required to forecast the next or following behaviour. Each episode consists of two data:
1. situational data,
2. five possible reactions, behaviours, attitudes, ... of the person to the situation.

For example:

situational data

During his military service he gains the confidence of his lieutenant, because he is the only married man and has two children already. He becomes the confidant, shows himself to be very discreet and is appointed a telephonist. This gives him the opportunity to render some services in his lieutenant's love affairs. At the end of his military service the lieutenant becomes interested in the future of X. As X. has no fixed goals the lieutenant advises him to apply for a job with the police. What will X. do?

five different reactions

a. he does not accept the lieutenant's offer and returns to his former employer.
b. he prefers to stay in the army.
c. he applies for a position in the police-force and is accepted.
d. he starts taking a course in electronics.
e. he applies for a job as an electrician in the city-services.

While the information on an event is always real, there is one and only one real reaction of the person. The task of the subject consists in predicting the real behaviour of the person described on the basis of the information given.
Then the subject is informed as to which of the five reactions did occur.
It is assumed that informing the subject of the truth of each forecast permits him to accumulate information about the person and that accuracy of forecast in a case indicates the subject's understanding of the case.

2. Construction of Programmed Cases.

To construct a programmed biography, the investigator uses single-case data collected in an intensive and idiographic study.
De Waele in his article about the Brussels Method (1976) stated that for a systematic personality assessment the convergent use of

four approaches is required:

1. the autobiography is the first step which must enable the person to give his definitions of his present and past situations and his own and other conceptions within his own time perspective.
2. direct observation of behavioural patterns in various institutional or social settings,
3. the social inquiry,
4. experimentally contrived problem and conflict situations.

These four sources of data are characterized by the fact that they are homogenious, because (a) they have to do with common every day behaviour and situations and (b) they belong to a world of meanings shared by the person and by the investigator: they are accessible to both, and expressible in the same ordinary language.
For these reasons the data obtained lead to accounts (justifications, argumentations, commentaries) whose correctness and authenticity can be checked by negotiating them with the focal person, and various informants. They can also be verified independently by field study as well as the use of documentary evidence.

However, to be coordinated with each other, these four sources of data must be linked to a common frame of reference and must, at least as far as 'first order constructs' are concerned, be integrated within the more or less unified system of cognitive structures manifested by the person. In order to reach these two objectives, a technique called the Biographical Inventory is used by De Waele (1979). This is a systematically organized collection of open questions, questionnaires and ratings which (a) are to be used by the investigators and by the investigated person alike, (b) are systematically linked up with the four sources of data mentioned above; (c) are so organised that multiple cross-references and comparisons are made possible; (d) once they have been analyzed, become the starting point for detailed interviews oriented towards situational and interactional structures and (e) allow for comparisons with other sources of information.

The reconstruction of a biography according to the Brussells Method of De Waele, which forms the basis of each programmed biography is the result of very intensive and idiographic research and conceived as a co-operative achievement a team which ideally consists of about half a dozen people, each bringing to the task a different professional background, such as a sociologist, a psychiatrist or psychologist and the participant whose biography is to be generated.

This life-history material is then divided into the smallest possible behaviour units, called episodes, that are still significant. By an episode we understand a behavioural event occurring at a particular time and place, in response to a particular situation; it has to include overt behaviour, words and gestures which indicate the feelings and probable motives of the person.
For each episode the case-writer then prepares four distractors: four plausible but fictitious reactions of the person to the given situation. Before the subject or student predicts the first episode of a childhood event and proceeds to study events in the life history in chronological order, he is given some more information about the social and familial background of the case person or participant. The aim of each programmed biography is getting to know the person. In order to control the plausibility of the distractors the participant predicts his own life-history and critizes the four distractors.

Until now nine programmed cases have been constructed and predicted by several students in the paper and pencil form: 3 cases of fifty episodes and 6 cases of twenty episodes. For more details about these cases see De Waele (1971) and Van den Brande (1984).

It is also possible to construct a computerized form of a programmed biography. It will be argued below that a computerized programmed biography has several advantages both for research and educational purposes.

3. On-line computer administering of Programmed Cases, by means of an author system, the Instruction Modulator Generator system (IMG), running on a mainframe computer, but also on a microcomputer stand alone.

The IMG system is an interactive computer network designed by IBM for computer-based instruction for non-computer specialists like educationalists or psychologists; so no computer background is needed. The IMG system has been especially designed to facilitate the two major aspects of computer based education: Computer Managed Instruction (CMI) and Computer Assisted Instruction (CAI).

Computer Managed Instruction: the software for CMI on the IMG system allows testing of students, routing of students to appropriate lessons and recordkeeping routines that keep track of the lessons the student has completed.

Computer Assisted Instruction: the actual lessons used for CAI or for CA research on IBM are constructed using the IMG system. This system is particularly effective for:
- displaying textual and graphic material,
- the input and judging of students, responses and controlled branching through the programme.

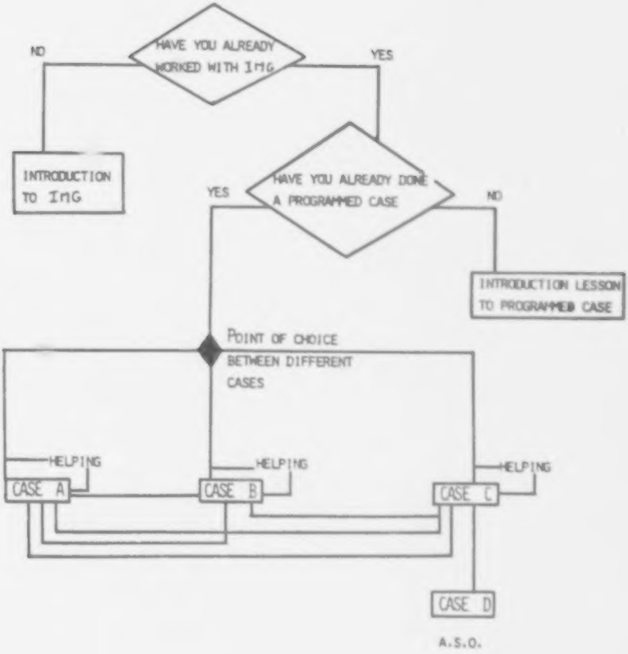
Within the frame of a research project at the Free University of Brussels (Department of Personality Psychology and Department of Education) I designed and programmed several cases.
A macro and micro outline of programmed cases on IMG are shown and explained. (see figures next pages)

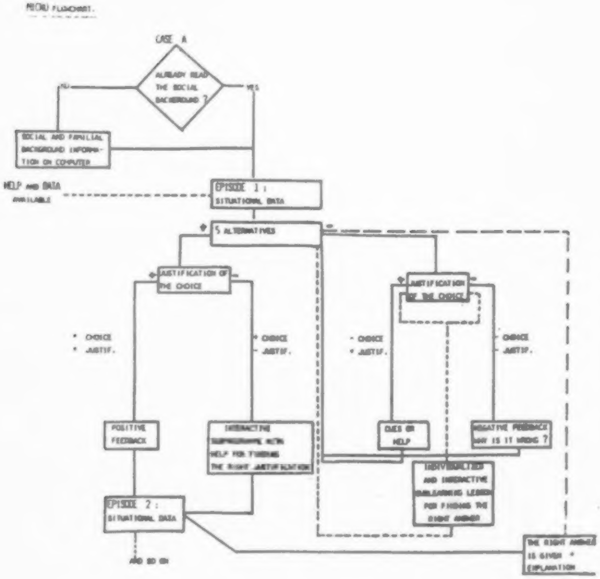
There are two introduction lessons, one by the IMG system and one by the P.C. method. Then the students are routed to appropriate cases, depending upon the interests, background, the student's former studies, and others.
The micro outline shows the structure of one single episode. First of all the subject reads the situational data and tries to predict the real behaviour of the person described, on the basis of the information given. At the left you can see the student's track. If his choice was right, he is asked for a justification. If the choice and the justification are right, he is given positive feedback. But if his justification is wrong he is routed to an interactive subprogramme with help for finding the right justification.

The right part of the outline is the track of a student who has made a wrong choice. After a second mistrial, he is routed to an individualized and interactive sub-learning lesson for finding the right answer depending on the answers to the episodes before.
So the feedback is different for each person. After a third mistrial he is given the right answer.

The most important advantage of CPC composed for paper and pencil administering are the interactive and invididualized responses.
The student works at his own pace; after each choice and justification of that choice the student receives feedback, namely cues, suggestions or exercises to do better. This feedback depends upon the route followed by the students through a programmed case. When the student has problems with an episode he can ask for more help... Besides interactive and individualized responses, sophisticated graphic capabilities ranging from line drawings to animation are possible. Microfiche facilities are also available, which involves the backscreen projection of images into the terminal (e.g. of a problem and conflict situation), and interaction is possible among terminals for predicting programmed cases in group.

FIG 1 MACRO FLOWCHART


HAVE YOU ALREADY WORKED WITH IMG
NO
YES
INTRODUCTION TO IMG
HAVE YOU ALREADY DONE A PROGRAMMED CASE
YES
NO
INTRODUCTION LESSON TO PROGRAMMED CASE
POINT OF CHOICE BETWEEN DIFFERENT CASES
HELPING
HELPING
HELPING
CASE A
CASE B
CASE C
CASE D
A.S.O.


MICRO FLOWCHART.
CASE A
ALREADY READ THE SOCIAL BACKGROUND ?
NO
YES
SOCIAL AND FAMILIAL BACKGROUND INFORMATION ON COMPUTER
HELP AND DATA AVAILABLE
EPISODE 1 : SITUATIONAL DATA
5 ALTERNATIVES
+
-
JUSTIFICATION OF THE CHOICE
+ CHOICE
+ JUSTIF.
+ CHOICE
- JUSTIF.
JUSTIFICATION OF THE CHOICE
- CHOICE
+ JUSTIF.
- CHOICE
- JUSTIF.
POSITIVE FEEDBACK
INTERACTIVE SUBPROGRAMME WITH HELP FOR FINDING THE RIGHT JUSTIFICATION
CUES OR HELP
NEGATIVE FEEDBACK WHY IS IT WRONG ?
INDIVIDUALIZED AND INTERACTIVE RELEARNING LESSON FOR FINDING THE RIGHT ANSWER
EPISODE 2 : SITUATIONAL DATA
AND SO ON
THE RIGHT ANSWER IS GIVEN + EXPLANATION

2: Micro Flowchart

So the advantages of CPC compared to paper and pencil administering are:

1. Automatic collection of student data by storing student records, responses and scores.
2. Control of presented information and randomization of potential variables such as order of presentation.
3. Routing of students to appropriate lessons and record-keeping routines that keep track of the lessons the student has completed.
4. Interactive responses.
5. Inidivualization: the student works at his own pace.
6. Product and process evaluation:
   Process a. after each choice and justification of that choice the student receives adequate feedback.
   b. when the student has problems with an episode he can ask for more help.
   c. after some mistrials (max of 3) he is given automatically some cues, suggestions or exercises to do better.
7. Sophisticated graphic capabilities ranging from line drawings to animation are possible.
8. Microfiche facilities are also available, which involves the backscreen projection of images into the terminal (e.g. of a problem and conflict situation), and interaction is possible among terminals for predicting programmed cases in group.

4. Programmed Cases as a research instrument and a training method.

Programmed Cases and Computer Programmed Cases can be used both

- as a research instrument for studying pscychological assessment, psychological insight and the methodology of single case study, and
- as an educational tool for psychologists, educationalists and other social scientists with the aim of improving their ability to predict behaviour and to understand persons.

Several experimental studies conducted at the Free University of Brussels revealed:

1. evidence that the understanding of other people or the ability to predict behaviour improved during a series of cases, and
2. evidence that a learning pattern was discernable within the individual cases.

The first findings indicated that subjects 'generalized' the results of what they were learning.

Research

The principal aim is substituting clinical experience by the development of a course-ware of Computer Assisted Programmed Cases to be used in the training of psychologists, educationalists, forensic experts and others.

a. Therefore an optimalization of the method as an educational instrument is a primary condition.
   The series of experiments treated here were related to the following 4 topics:
   1. psychometric research: difficulty level, error analysis, item discrimination or validity, item reliability.
   2. learning within the scope of a case: does the subject 'learn' about another person in the sense of making increasingly accurate predictions of the other person's behaviour as he receives increasing amounts of information about that person?
      To test the learning within the scope of cases, one may compare the prediction score of all subjects at successive points within the cases. The method used was a correlation between the first fourth (QI) and the difference between the first fourth an the fourth (QI - Q4).
      An experimental investigation (Thewissen, 1967, involving n=29 subjects) making detailed analysis of three cases (AB, D and X) revealed that the Programmed Case Method did in a fact result in measurable improvement in the ability of the subjects to make 14 predictions.

      Case AB r = + 0.64
      Case Dr = + 0.49
      Case Xr = + 0.87

      fig. 3: correlation between QI and
      (QI - Q4) (n=29)

   3. learning between cases: Is there a generalization of this prediction skill of subject from one person to the next?
      To test the generalization of the skill from case to case, the prediction scores of all subjects at successive points during the series of cases were compared (n=29) (Sloore, 1967)

Case	first choice	s	sum of trials	s	%
AB (52 epi.)	27.34	8.22	90.76	19.09	52.57
D (56 epi.)	31.69	9.44	93.96	21.32	56.59
X (56 epi.)	34.48	9.38	89.24	18.40	61.57

fig. 4

The correlations between the cases are relatively high, when we take into account that the cases are very different in content.

	r	
AB (1) - Dr (2)	+ .73	(p=0.001)
AB (1) - X (3)	+ .64	(p=0.001)
DR (2) - X (3)	+ .77	(p=0.001)

fig. 5: Correlations between the cases

4. No significant correlation was found between programmed cases and cognitive complexity (REP-test), ego identity of Kelly- test, examens, vocabulary test and intelligence (Cattell).

cognitive complexity	ego identity		examens in (n=29)		
AB+D+X	+0.05(ns)	-0.11(ns)		MATH.	MATH.
AB	+0.03(ns)	-0.05(ns)	+0.02(ns)	0.00(ns)	0.27(ns)
D	+0.11(ns)	-0.16(ns)	-0.11(ns)	-0.21(ns)	-0.01(ns)
X	-0.00(ns)	-0.06(ns)	-0.13(ns)	-0.27(ns)	0.00(ns)

	Vocabulary	Cattell (n=80)
AB+D+X	-	- .12(ns)
AB	- 0.13(ns)	- .25(ns)
D	- 0.15(ns)	- .15(ns)
X	- 0.19(ns)	+ .01(ns)

fig. 6

However, these results can be critized on several points and further research is necessary. It can already be concluded that subjects do 'learn to know another person' if the data are programmed as in this experiment and that there is a measurable degree of generalization of this skill to other cases. The implication for education is that something may, indeed, be learned by the case method.

b. Gaining new insights in the field of conceptualization and judgment of persons.

Four steps were essential in predicting Programmed Biographies:

- a. Noting the significant: significant statements are:
  - (1) the ones about the events most likely to influence the future behaviour and attitudes of the individual.
  - (2) the ones that show an action or an attitude that may be characteristic of the individual.
- b. Interpreting the data by questions like "What is this person trying to do?", "What kind of approach does be take in trying to do it?"
- c. Forming the image: an observer must construct a mental image of an individual so that he will be able to tell why that person acts as he does.
- d. Comparing episodes with the image.

Further research involving these 4 steps is necessary in order to answer the questions below:

- a. What should a subject predicting a programmed biography discover? or an analysis of the tasks of each case.
- b. How does a good performer solve these tasks?

  Does the use more data and argumentations to claim an alternative? Does he predict as he is moving along a programmed case according to a growing abstraction level? Does he use 'naïve' personality theories and, if so, which one is useful?
- c. How can bad performers be taught to predict more accurate programmed biographies?

  Research has shown that initial lessons for adequately using the four steps and feedback at several stages helping the subjects to argue their choices and better conceptualize the person, increase the accuracy of prediction by 25% (n_{AB}=81; n_D=84).

  On these results we designed and programmed three IMG Programmed Biographies with a lot of feedback and sub-learning programmes. In current research (n = 40) we are testing the hypothesis that subjects perform better on Computer Assisted Programmed Cases than on the paper-and-pencil version.

5. Conclusion

By way of conclusion, it can be stated that a series of Programmed Biographies and Computerized Programmed Biographies constitute an adequate training in the clinical study of an individual case (clinical didactics).

It should be noted that (1) also psychopathological data can be inserted in Programmed Cases. This would allow to incorporate a training of the DSM III diagnostic categories in a study of all single persons. (2) Not only biographies but all processual psychological data (i.e. action psychological data) can be the subject of the programmed instruction method.

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TECHNOLOGICAL DEVELOMENT, "TECHNOLOGICAL MIND" AND SCHOOL. SOME ASPECTS IN COMPARISON WITH SPECIAL REGARD TO SOCIALIST COUNTRIES AND JAPAN.

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In the following I use the terms 'basic values of technological structures', respectively 'technological mind', in reference to a general paradigm following which the modes and means of production and the character of labour determinate to a certain degree the social organization and its reproduction in the educational system.
This paradigm is not at all new, several historical and contemporary studies recur to it. The problem with such a paradigm apparently is not its plausibility, but to follow exact lines of proofs for the stated correspondence, from the high level of generalization through the different levels of complexity down to the single social actions and basic social institutions. I am convinced that this problem is not a data problem, but a substantial one. Probably between systems of different complexity such a path of unequivocal correspondences cannot exist. At least this seems to be the message, the theory of complex systems tells us.

Anyway, adhering to some paradigm obliges us to continue the search for such paths, in accordance with our constant search for a better understanding of relationships between different levels and spheres of social organization.

Much research has been undertaken to prove the correspondence between the general features of societies, for example in their different stages of capitalist (industrial) development on the one hand, and the function of educational systems reproducing in principle the correspondent class structures (social stratification and labour specialization) on the other hand. Rather little attention has been devoted to more detailed levels of analysis, as for instance the attempts of Bowles and Gintis in their relevant and detailed work, they try to prove the existence of a chain of correspondent structures between working conditions, family and school/education. Although I find the attempts convincing in many respects, I miss both a more dialectical connection between the factors of human labour and technology and a more basic discussion of both.

The present crisis of unemployment, as far as it is not attributed, to simple economic recession, is for most people clearly linked to the new technologies. However, not only for this topical issue, and not only for the deep involvement of school in forming attitudes towards technology and preselection for the labour market, but for the fundamental meaning of technology and labour for man, educational science must consider the problems in question.

At least since Max Weber, we have been accustomed to connecting the question how modern industrialism developed with the evaluation of certain preconditions and conditions of a specific value structure, which we summarily designate as the principles of (western) rationalism. We could designate such a structure as the 'technological mind'.(1) We are equally accustomed to seeing the impact of industrialisation(modernisation) as universal. As it is expressed in the words of Ignacy Szaniawski, the prominent Polish educationalist: "Now the matter is, that both, the first phase (of scientific-technical revolution -B.v.K.), mechanisation and the second, automatisation, being children of rationalisation, by their thrust for conquest and their determinism, inexorably transform the structures of labour, compensation and education in general, job structure and the content of vocational education... and this independently from geographical situation, political forms of government and economical systems."(2)

The assessments of rationalism penetrating all spheres of society vary greatly: It was Horkheimer and Adorno, who gave their sceptical diagnosis on the 'progress of industrial society' in which the dialectics of enlightenment and reason turn, as they say, objectively into insanity.(3) For them the possibilities of deformation are laid down in the basic definition of reason, which is being able to take distance from and against nature, includes this possibility, but there is a necessary interrelationship between science with its very methods on the one hand and a man-made universe of power and exploitation (of nature as well as of man) on the other hand.(4)

Again Habermas stresses the one-sidedness of modern rationalism as technically-instrumental (5) and calls for the completed definition of praxis by introducing the principle of communicative action. He summarises his uneasiness with the one-sided turn reason as instrumental and functional rationalism took in the process of modernisation by describing this as a "colonialisation" of interactively-communicative reason (6). Of course there are many other voices, expressing that modern technics are no longer controlled by man, but control man. However, it is mainly the Frankfurt school which sets the problem at the very basis of modern technology, on science and reason as its preconditions.

Again, there are others, who are much more optimistic about rationalism. Talcott Parsons regards capitalist economical rationalism as a factor of social modernization and freeing man from particularistic mechanisms (7). Milton Freedman argues that an entrepreneur adhering to economically irrationalistic prejudices (for instance racism, religions) in his hiring practice, would impose on himself - by restricting himself to a reduced labour market - higher costs of production and would worsen his competitive situation (8).

The afore-mentioned American Bolwles and Gintis, although basing themselves on a "correspondence principle" between labour and education, refuse strictly the argument that alienated labour is a necessary outcome of modern technology. If it would be, "then technology, and not capitalism would be the core of the problem" (9). To support their argument, they claim that even in the frame of the existing technology, labour could be organised in a way that it would be more satisfactory for the worker (10). Arguing that not technology is the main problem, the historical process of expansion of education is thus not due to the demands of the developing technology, but due to the power structure in industry and the interest of those in power to adopt changing conditions: 1) Expansion of education produces the power of the capital owner over labour and 2) with the same effect, the introduction of new technology means dequalification for the traditionally skilled (11).

Following the interpretation of Bowles and Gintis, one could argue that there are only two possible conditions for knowledge on the side of the direct producers - either to keep the existing level of technology (which they don't propagate)or to give an education procuring such prospective knowledge that new technology does not imply the threat of dequalification. But if the expansion of education did not guarantee this, we could think that the really crucial expansion of education did not expand. In fact, they see the "monopolization of control over technical information by the management" (12). However, they do not follow this central aspect by analysing the contents of the knowledge accessible through education on the one hand and the technical knowledge necessary to keep control (Herrschaftswissen) on the other hand (13).

Similarly as do Bolwles and Gintis, already Erich Fromm claimed that under the conditions of existing (and developing) technology labour can be made more satisfactory and productive and less alienating (14). Giving detailed references to manifold postwar models of the humanization of labour, he formulates his central demands: overall knowledge (of technical and economic conditions of production) and participation (in decision-making) of the worker.

Reading Fromm, one could gain the impression that Japanese industry carefully studied those models and, adapting them to the local conditions, imported them. As known, a central aspect in Japanese industry is the linkeage of the principal's satisfaction in and through labour and efficiency of production. Interestingly enough, efficiency of production does apparently not simply mean gaining faster or harder working labourers, but gaining their special knowledge of production, which is accessible only to them (15). Typically this organization of production conditions shows some general similarities: 1. creation of an emotional and practical entity, which to a certain degree smoothes the keen division between in-and out-of-plant activities, and is bound to foster a strong identification with the producing community; 2. the introduction of 'non-rationalistic, non-instrumental' aspects into production; 3. moderation of the 'hire and fire' principle, in the extreme case the famous life-long employment (which however is adopted only in some large enterprises with about 20% of the industrially employed); 4. institutionalized, free flux of information, down and upward in the hierarchy; 5. some measures which counteract extreme division of labour; 6. weak or no representation of unions other than branch- or factory-bound.

Interestingly too, this character of labour conditions - which are naturally more diversified and here only roughly outlined as a tendency - does not correspond to an educational system, which especially stresses knowledge of the technical side of production. In simple words, Japan did not gain a leading position in High-techs, because there had been a computer in every school since long and pupils trained in information science. This is not the case at all. Despite some polytechnical aspects and vocational tracks, the generaly educational ("non-qualificatory") component plays a decisive role in the Japanese educational system (16).

Correspondingly, profession and professionalism both in the educational and in the employment system are much less valued than in Europe.

Apparently this system is very different from that of the European, and especially from that of the socialist countries. In a way the latter, at least ideologically, is based overall on the tradition of European history, which is intertwined with the value of what I called, the 'technological mind'. The recent corresponding theoretical analysis has been elaborated (since the sixties) under the slogan "scientific -technical revolution". So it is not surprising that these countries exceptionally not only foster a scientific outlook on the world in the curricula, but also professional, and above all, technical education.

As a rather extreme example, I would like to refer to Czechoslovakia, where the share of technical enrolment in higher education comes up to 54% of the total. In Japan, comparatively, this figure is just 20% (on the comparative university level; on college level it is only 10%). What is striking is the fact that compared with this "input"-relation in education, the "output" (that is, if we follow the socialist theory of economic spheres of national economy and the position of technical education in it) is nearly the exact opposite: in 1970 from all employed graduates in Czechoslovakia, only 20% were employed in industry (but most in the 'non-productive' sphere, and the great bulk - 34% - in education); in Japan, from all graduates leaving higher schools in the same year, nearly 40% entered industry (education 11%) (17).

How can this 'contradiction' be explained? It goes without saying that several factors have to be considered. But clearly an important one can be found in the fact that the educational system is 'relatively autonomous'. Apparently it deals with process planning as well as "spontaneous demands" in a specific way, and secondly this processing has to do with both the economic (social) and the cultural systems: this processing is not only "contradictory" with respect to proclaimed (or traditional) strategies, or, as for Japan, transforming "general education" easily into highly effective and dynamic technical and technological qualification. This processing and its effectivity is moreover embedded into a socio-cultural context, which in some important respects "contradicts" the usual scheme of how modernization conditions the intruding of the "technological mind" into society and culture.

'Technological mind' was here used very generally; however, it has to be, at least to a certain degree, specified more precisely. Under the general definition of 'scientific', 'rational' etc. it includes the assumption that the basic values underlying modern industrial production could be identified more systematically and in more formal language. This enables us to identify 'technological mind' in very different social relations, which are, as we said, the outcomes of different processings.

I would like to restrict myself to some aspects only: for example there is the aspect of (modern) time. Its formal quality, crucial for science and technics, as providing an exact and stable instrument of measuring, is the fragmentation of processes into equal sequences. It is in this sense that I speak about adopting a 'technological mind' (or, if we want to see it critical by: the 'colonialisation of social spheres - Habermas' "Lebenswelt"), if those principles, logically and basically connected with the modes and means of production, intrude - as values - in areas, which by their nature are not necessarily structured by these values. A combination of the time aspect with that of limited resources and that of the exact measurement of material and functional parameters, gives rise to a technological rationality, which values above all the maximalisation of these parameters and which can be measured unequivocally.

Apparently, the acquisition of knowledge and education can be done in an organisational form which corresponds to these technological principles. However this is not the only possible, and perhaps not even the most effective mode (seen from the logic of the system in question). Thus, for instance, knowledge is not a scarce resource (18), its acquisition is not necessarily to be divided into equal time intervals and its evaluation in a grading system which pretends that - as it is the case in hard technologies - an unequivocal correspondence between all factors of input and output can be established, is not the only possible one. It seems that there exists a deeply rooted correspondence between modern school and factory. One could find many examples that people concerned with education held and expressed this opinion (19), but this correspondence was also tried as a means to evaluate the degree of "modernisation". An American study in 6 developing countries operated with a list of 10 attributes for defining certain attitudes and values giving rise to the behaviour of the "modern man". The compared samples consisted of groups with different schooling or factory experience. As an outcome it was found that: "The longer men are in a factory, the smaller becomes the gap in their modernity scores, because the men with little education come, through their factory experience, to catch up with those with higher education" (20). The authors of the study answer the question, which were the factors of stimulating modernisation in schools and factory equally, with the distinctive nature of the social organisation of school - and the coordination of fragmented time and fragmented work is a central aspect - not with the contents taught, the ..."Curriculum, considered by educators to be the core of education, has at best a minor role in generating modernity" (21).

However, apart from this rather general level, apparently the impact of "technological mind" in school and society, can vary greatly in different cultural and social systems. As for the Japanese school, an American scholar, Thomas P.Rohlen, made a very competent study of it summing up his field work, elaborating among other ones, the aspects of time and space organization, stressing the differences with American schools (22).

There is plenty of literature about the observation that in Japanese society aspects usually thought to be crucial for "modernism" are implemented only to a certain degree and in coexistence with aspects usually defined as traditional. Thai refers to what could be expressed in the slogans universalism versus particularism (see above), individualism vs group consciousness and consensus vs contract principle. Partly these single definitions overlap; however, basically 'non-modern' or 'non-rationalistic' patterns are to be found in all areas of society, also those which are usually regarded as affecting economic (or 'technological') effectivity.

In the correspondent literature one typical employee is described as being hired for the reputation of his alma mater rather than for his achievement in preparing for a certain profession, probably because the manager of the personnel affairs division and many of the other staff graduated from the same school. His in-plant training consists of passing through all relevant sections of the enterprise. Being integrated in the group of his graduating-year mates, his salary will increase conformly with this group in accordance with the seniority principle. If he proves to work rather efficiently, an appropriate working place or function in a working group will be found for him, following the principle that everyone is at least talented for something, be it for taking the role of the group leader with the important task to secure the harmony within the group. Having some conflict with his neighbour, his employer or the man who sold him his new car, he would think it over more than twice to hire a lawyer and thus rather rely on universalistic rules. He would try to settle the matter by mediation through a confidential person, who, by by general consent is authoritative for both parties. (The number of lawyers is, compared with other industrialized countries, extremely small). His social status depends above all on his loyalty to a group. If he is suspected of trying to find a solution individually, even if it is technologically convincing, he has a hard stand. On the whole, he makes many decisions and behaves following a value pattern, which in its central aspects is not technologically 'rational' or 'efficient' (23). The children of our fictitious salary man will enter school and there, as everywhere, be subjected to a teaching in fixed time - and content -sections. However, the time devoted to single contents and activities will be different. After having been brought up in a traditionally developed educational style which still to a certain degree respects different phases (24) and on the whole counts with (as for the girls: supports) a slower maturing process than in Western culture, they spend relatively little time in spontaneously created peer groups, but much time in cramming knowledge they definitely will never need directly for the efficient fulfilling of technological tasks. Sure, at last they will be exposed to the intensification of meritocratic values in senior high school, but before they have also learnt to value particularistic group and consensus structures. By electing class mates for school offices like speakers of the class or group, they learn to deny "the moral validity of majoritanism" (25).

It goes without saying that our example is highly schematical and ideological, but in reality, it is clearly traceable in different degrees of realization. However, in spite of having apparently adopted the 'technological mind' only to a certain (and from a Western point of view: different) extent, Japan, without doubt, has adopted and developed the technologies of modern industrial society exceptionally successfully.

The interculturally comparative question then is, whether technology has to be regarded as a 'parcel' which can be accepted or adopted only as a whole and conditions the same consequences for value structures, division of labour etc. everywhere, or whether dealing with it leaves contingencies and can lead to new syntheses varying with the cultural and social system.

Apparently at the present there are three regions, where this question explicitely or implicitely plays a central role in social politics: in parts of the Islamic world, in parts of Asia and in the socialist countries. As for the latter, the situation is different from the others, as their politics do not strive for taking over technology selectively, but for developing the heritage of Western rationalism and science, in order to create the "new man" and, with him, a new culture. We could, of course, settle the matter quickly by stating that declared goals are ideologies only serving to mask or legitimate other goals. To what extent this will ever be the case, it is not more at the core of the problem in question, than if technology will leave any room at all for contingent choices.

Japan was, and is up to now, the only non-Western country, which has succeeded in technologically and economically catching up with the leading industrial nations. From the very beginning of modernization the ambiguity of becoming Western was felt and stimulated politics and theoretical discussions. Extreme standpoints in 19th century's Japan even expressed the need to mix racially with Western people, to give up the own language and, on the other side, there were Westerners who proclaimed that without at least becoming Christian, there would be no real chance of becoming an industrially and socially modern country (26).

Sure, the time span from the beginning of its industrial modernization up to now is too short as to decide definitively if the outlined coexistence between 'traditional' and 'modern' patterns is really not only transitional. But, evaluating the development now, it seems also, that the question of contingency is among other things a question of power. At least for Japan this was - apart from mechanisms of a general interrelationship between industrialization and imperialism - a strong motive for its pre-World War II variant of nationalism, military build-up and expansion.

At present, the whole question gains a new quality with the recent development of technology. Again I want to limit myself to some aspects.
With the most dynamic of the new technologies, a quantitatively new level seems to have been reached. The material and non-material means of production, its inherent logical structures, but also the locations for contingencies will probably change. For instance, the basic principle of "classic" production technology consists in the mechanical usage, transmission and multiplication of energy. The chain of non-material and material links connecting the knowledge of physical laws, construction plans and production is highly diversified, but generally, to set up this type of production means total control over every single aspect in a chain of causal processes. In a way the classical alienation of wage labour under those conditions of production can be ascribed to the fact that the employer has at his disposal the command and exploitation of the physical side of the labourer.

Most of the very new and expansive technologies, such as information processing and biological production, the latter both under the aspect of genetical engineering and production by means of organic cultures, shows fundamental differences. The aspect of physical energy - leaving apart the question of a "clean" energy supply - plays a tiny role. Even the development of industrial robots which work "manually", is chiefly concerned not with magnifying the physical strength of their actions but, on the contrary, with splitting their energy into highly differentiated functional actions in a low-power range. Biological production adopts the black-box principle to a certain extent, which is unthinkable for any mechanical power engine. This makes the total control of cause-effect links unnecessary, if the overall control is secured. The same is true of extremely high- complex information processing, which cannot function by a mere massing of stochastic (deterministic) algorithms, but must include "free-choice" positions.

However, it seems, that the stage of technological development securing free man from mechanically hard work, does not automatically do away with alienation, it rather transforms it. Thus E. Fromm pointed out that whereas the wage labourer of industrialisation was stripped of the free disposition of his bodily actions and energies, but his character, ideas and wishes were not subjected to direct control (because this was not necessary to secure production), the new type of (blue- and white-collar) labourer places his moral and social skills at someone's disposal. Recently there was a notice in the newspaper that in the USA some clinics offer cosmetical operations, which will bring the applicant for a job in conformity with certain facial features which signalize certain character features. Under such conditions the labourer - paraphrasing the famous sentence of Marx (27) - seems to be outside himself and not at home, even if being at home.

As for information technologies, the chain of non-material and material links, as I called it earlier, has been shortened substantially. In another way than with the classical machine technology, where pre-production basical research, construction modelling, production and product, were subjected to several totally different kinds of materialization (formal languages, possession of heterogeneous natural materials), in information processing the in- and output systems have the same material and structural quality. In addition, by the combined use of formal and natural languages, man is tied to the logic of production in a new totality. It seems that parallel with modernization, and the more production augmented the number and structural diversities between man and its product, the function of a language as - indirect and mediated - action grew. Again, in information technology this process gained a new quality - an identity of "word" and action. Symbolically I find this expressed in the following argument, by which the New York Times expressed its criticism on Reagan's visit to Bitburg and the diplomacy of appearances: "This diplomacy of appearances insists that every presidential act has strategic significance: since peace depends on nuclear weapons that can never be used, a president's willingness to use them rests entirely on threats and promises - on words; therefore, a president's words carry cosmic weight..."(28).

If we compare today's primary books for the mother tongue in the Federal Republic with those of some 30 years ago, we find a radical change. In short, the instrumental character of language became absolutely dominant. Surprisingly, both in the socialist countries and in Japan, at least up to now, this is the case to a much lesser extent (if at all). Of course this is astonishing especially as to Japan, which is at the top with this kind of technology. It makes a less scrupulous use of it and sees in it (respectively in a variant of usage of this technology, the "service society") great perspectives for the future. We could conclude that in Western culture the acceptance of new technologies is so strong linked with the correspondent changes in the ideological sphere, that the need for legitimization is predominant, in Japan cultural legitimization and the use of technology belong to more separate systems.

Notes

1. With this term I am referring to Rolf E.Vente: "The 'technological mind' and other issues of current exchange research" In: DIPF: Mitteilungen und Nachrichten.,(1982) 106/107, p.18-29 and the same (ed.): Erfahrung und Erfahrungswissenschaft. Stuttgart 1974.
   Vente argues, based on his research in developing countries, that the intake of industrial modernization is linked with the acceptance of the 'technological mind' - in German "erfahrungswissenschaftliches Prinzip".
2. Ignace Szaniawski: "Determinanten der Humanisierung der Arbeit im Zeitalter der Automation." In: DIPF: Mitteilungen und Nachrichten (1981) 102/103, p.1-15.
3. Max Horkheimer/Theodor W.Adorno: Dialektik der Aufklärung, Frankfurt, 1971; see also: Helmut Peukert: "Kritische Theorie und Pädagogiek." in: Zeitschrift für Pädagogiek, 30 (1983)2, p.195-217, p.195.
4. Herbert Marcuse: Der eindimensionale Mensch, Frankfurt 1967, p.180; see also: Rolf Huschke - Rhein: "Die halbierte Humanität" In: Zeitschrift für Pädagogiek, p.241-242.
5. See also: H.Peukert: Kritische ... op.cit. p.207.
6. Jürgen Habermas: Technik und Wissenschaft als Ideologie, Frankfurt 1968,p.93.

7. Talcott Parsons: The social system. New york: The Free Press 1951. Particularistic mechanisms are decisive factors of social, racial, religious etc. criteria structures (namely in traditional society) prevailing over "universalistic" criteria determined by principles of rationality, for instance "meritocracy".
8. Milton Friedman: Capitalism and Freedom. University of Chicago Press, Chicago 1962, p.21. His example: someone buying a loaf of bread does not know if a white or black man, a Christian or a Jew worked in the field, and followingly, the producer was able to use his resources as efficiently as possible, independently from prejudices of the community (consumers). He ignores that these prejudices are generally expressed in the wage structure and the accessibility to jobs.

   By the way, the very same example is used by Marx to illustrate the difference between exchangeable value (Tauschwert) and utility value (Gebrauchswert). Zur Kritik der politischen Oekonomie, MEW, Bd.13, S.16
9. Samuel Bowles, Herbert Gintis: Pädagogik und die Widersprüche der Oekonomie. Das Beispiel USA. Frankfurt: Suhrkamp, 1978. Schooling in Capitalist America. Educational Reform and the Contradictions of Economic Life. New York: Basic Books 1976: here quotations from the German issue.

10 Ibid.p.95

11 This is in principle, what Marx analysed for a certain historical situation: "Nearly all new inventions (after the crisis in England 1825 - B.v.K.) were the result of collision between worker and entrepreneur, who at any price tried to devaluate the vocational quality of the worker. After each new strike, a new machine was developed." (Das Elend der Philosophie, MEW, 4, p.155)

   However, for Marx this is not an invariability, but true in a concrete historical situation and imbedded into a dialectical process. He somewhat later reasons that by the division of labour in the mechanical factory, it(labour) loses any special character: "but from the moment on, when every special development ends, the need for universalism, the striving for a well-grounded development of the individual begins to be felt. The automatic factory does away with specialists and with one-track-professionalism."(Ibid.,p.157)

12 Bowles/Gintis: Pädagogik ... op.cit.,p.95.

13 By the way, it is perhaps not technical knowledge which is monopolized and gives control, but social knowledge under the conditions of modern pluralistic-society. After all, the students of social sciences proved to be the most rebellious and active in the movements of the late 60s and early 70s.

14 After having initially criticized the labour conditions substantially and in reference to the demand of Marx to "abolish

labour" (as it is called in his early writings), this turn can be interpreted as a "revisionist" strategy to cure capitalism, but not to abolish it: Erich Fromm: Wege aus einer kranken Gesellschaft. Stuttgart: Deutsche Verlags Anstalt, 1980; and: the same: Das Menschenbild bei Marx. Frankfurt: Ullstein, 1982

15 See K.Dobse, U.Jürgens, T.Malsch: "Vom 'Fordismus' zum 'Toyotismus'? Die Organisation der industriellen Arbeit in der japanischen Automobilindustrie." In : *Leviathan. Zeitschrift für Sozialwissenschaft* (1984)4, p.448-477.

16 On the other hand Japanese highschool seniors seem incomparably better informed about political economies, worldtrade conditions and so on, than their American counterparts. For example, among the latter, as a 1974 survey showed, only 41% could locate Egypt on a map: Thomas P. Rohlen, Japan's Highschools. Berkeley: University of California Press, 1983, p.100/254.

17 The figures are not completely comparable, not only for the - minor - differences in defining industry, but becauee the figures available for Japan represent the graduates of the given year; but the tendency for a general trend for the Japanese figures (growing share of graduates employed in the industry) can be found in the corresponding comparison with the year 1950: in this year only 22% had entered industry, but 37% education. Sources for figures: Statisticka rocenka CSSR, Prague: SNIL, ALFA, 1980, p.203 and U. Teichler: Geschichte und Struktur des japanischen Hochschulwesens. Stuttgart: Klett 1975, p.207.

18 This aspect is treated in N. Luhmann, K.E. Schorr: Reflexionsprobleme im Erziehungssystem. Stuttgart, Klett-Cotta 1979.

19 There are some examples quoted in Bowles, Gintis op.cit., p. 187-220. See also: E.P.Thompson: "Time, Work-Discipline and Industrial Capitalism". In: *Past and Present*, 36, p.56-97 and Thomas P.Rohlen: Japan's High Schools. Berkeley: University of California Press 1983, p.145-169.

20 Alex Inkeles and David H. Smith, Becoming Modern, Individual change in six developing countries, Cambridge, Mass., 1974, p. 272-273. Quotation here from: Noel F. McGinn and others, Education and Development in Korea, Cambridge, Mass., Harvard University Press, 1980, p. 191

21 N.F. McGinn, Education and Development in Korea, Cambridge, Mass., Harvard University Press, 1980

22 Thomas P. Rohlen, Japan's... op cit., especially chapter 5

23 R. Vente, Erfahrungswissenschaftliches Prinzip und Verhalten., in: R. Vente (ed.), Erfahrungs... op cit., gives examples from very different areas of social action in developing countries for the invasion of the technological mind,

for example sports - where the measuring of fractions of seconds or centimeters displaces consensous acknowledge of the winner, traffic where the 'contract principle', that is a set of abstract rules, removes situational agreements, etc.

24 Formal expression to this are in the 3rd, 5th and 7th birthdays, which are celebrated by special ceremonies, usually in a shrine. The meaning of this scheme - which is traditionnally inversed to 7-5-3, destignating generally the set of these birthdays and of the lucky numbers - is so well known, that Japanse, criticising the drawbacks of the educational system, especially the uniform teaching and achievement system, refer to it as the 7-5-3-system. In an ironical turn, this contrasts the usual designation of the Japanse school system as a 6-3-3-system, which means the years of elementary, junior and senior high school; using a Japanse word which can designate percentiles, the new meaning is then, that in elementary school 7 percentiles = 70% of all children pass succesfully and with appropriate understanding for the taught contents the grades, in junior high 50%, and finally in senior high (which is not compulsory but enroles over 90% of the age group) only 30%.

25 Robert A. Scalpino, Junnosuke Masumi, Parties and Politics in Contemporary Japan, Berkley and Los Angeles, University of California Press, 1962, p. 152 and Joseph A. Massey, Youth and Politics in Japan, Lexington, Toronto, London, 1976, p. 58-69

26 See for example: Marius B. Jansen (ed.), Changing Japanese attitudes towards Modernization, Princeton, 1965

27 Okonomisch-Philosophische Manuskripte, MEGA, Bd.1, here from: E. Fromm, Das Menschenbild... op cit., p. 89

28 International Herald Tribune, May 7, 1985, p. 4

INSTRUMENTAL VS. DISCIPLINARY CURRICULA: A COMPARATIVE PERSPECTIVE

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Changing employment patterns and austerity affect cultural and curricular content in an educational system. Considering Thorstein Veblen's dictum that "...higher learning takes its character from the manner of life enforced on the group by the circumstances in which it is placed" this paper looks briefly at Europe and U.S.A. and narrates both the conceptual and the statistical aspects of the shifts.

The general position was perhaps best enunciated for U.S.A. in the Newman report on Higher Education (H.E.W. Office of Education report by the Chairman of Task Force Frank Newman, 1971). It puts forth "skills and training" as the ends of college education, i.e. the direct products of cognitive investment, whereas the process products of a college education emerge from The American University (Talcott Parsons and Gerald Platt) as the most important outcomes. Parsons and Platt held that graduate training and research are the core of the university, where the commitment to cognitive rationality is translated into the canons of the various disciplines. The Newman report, however, advocated that students be socialised to the world of work and be related to the university as a source of useable knowledge in place of the Parsonian socialization to rational modes of behavior.

For Parson and Platt, courses should conform to the strict professional standards of academia: for Newman professionalism would be de-emphasised by the introduction of practioner knowledge from the workplace.

Elite institutions on the American scene are still likely to be governed by the demands of disciplinary inquiry. The middle ranks of universities, a central part of the David Riesman/Christopher Jencks "academic revolution" and previously large gainers of academic, scholarly, research prestige are now dominated by instrumental, as opposed to disciplinary, knowledge and vocationalism. The Newman report described, predicted and perhaps would have applauded what has happened to the middle-rank American universities, but it did not cause the change. The changing labor market, the austere economy and the cessation of growth in American higher education (demographic change) were the major factors.

There has been, then, a general trend away from disciplinary majors in favor of instrumental subjects. This trend is especially noteworthy in view of the steady decline in education majors. In the class of 1977 the business majors for the first time surpassed education as the largest category of graduates, comprising one of every six bachelor's degrees.

The following data showing change from 1964 to 1977 in percentage of total number of higher education students in the U.S.A. document this conclusion:

For academic disciplines

	1964	1977
Per cent of Total	48.4%	42.1%
Letters	8.7%	5.1%
Social Sciences	17.0%	12.7%
Mathematics	18.6%	14.3%
Foreign Languages	2.7%	1.5%
Physical Science	3.8%	2.4%

For instrumental knowledge

	1964	1977
Per cent of Total	51.6%	57.9%
Business	12.2%	16.6%
Education	24.4%	15.6%
Health Professions	2.5%	6.2%
Computer Science	-	0.7% (clearly much higher for 1984)
Journalism/ Communications	0.5%	2.5%

Source - National Center for Educational Statistics, Digest of Educational Statistics 1966, 1970, 1975, 1978.

Jencks and Riesman note that "the desire for professional training pre-dated the existence of a body of knowledge needed by practitioners" (Academic Revolution p. 203). Business schools by incorporating organisational analysis, quantitative techniques, game theory and the case method have attempted to bring some semblance of discipline to their previously highly instrumental curriculum ("academic drift"). But for most non-technical professional programs the relationship between course work and real work is obscure.

The lack of relevance of classroom material for the intended para-professional, professional or technologist, however, does not deter students so long as employers give priority to the specialised, instrumental degree holder graduate in winnowing their applicant pool. Along with this tendency comes the dwindling prestige of disciplinary graduates as well as changes toward the instrumental in the middling higher education institutions.

A recent example of the impact on curricular content by the nature of contemporary jobs and changing work functions in society is the dispute between accrediting agencies and universities about the content of a computer science major.

Liberal arts colleges have stated that the proposed accrediting standards for college computer science programs give too much attention to the needs of industry and ignore the philosophy of liberal arts institutions. These accrediting standards were developed by a joint committee of the Association for Computing Machinery and the Computer Society of the Institution of Electrical and Electronics Engineers, the two major national organisations for computer scientists.

Computer science professors from Bondoin and Colgate charge that by setting standards for accreditation that are based on industry needs, the organizations "would irreversibly erode the distinctive quality" of a liberal arts degree in computer science. (Chronicle of Higher Education June 13, 1984). They would rather educate a B.A. not only well-trained in computer technology but also exposed to a variety of disciplines which teach inquiry, analysis of information, synthesis and communication.

The accrediting agencies insist on a curriculum that is heavier on technology and employability, stating that "2/3's of computer science graduates have difficulty fitting into the workaday world."

They asserted, "Accreditation was set up not to accommodate the colleges, but to accommodate the profession."

By the Fall of 1985 the accreditation agencies want the following criteria to be in place:
In a four year program 1 1/2 years of computer science, 1 year of related courses such as mathematics and physics, 1 year of general education requirements and 1/2 year of electives.
At least 5 full-time faculty members, one of whom would serve part-time as department chairman, the preponderance of faculty members to have Ph.D's in Computer Science.

II

In Western Europe the challenge of austerity and increasing vocationalism brought somewhat different responses. Public sector employment had always been the outlet for the majority of university graduates. In West Germany, for example, between 2/3's and 3/4's of the jobs open to graduates had been in the public sector according to the Central Employment Placement Office (Nuremberg). The statistics for 1977 in Sweden show that six months after graduation 2/5's worked for local government, 1/4 for central government and somewhat more than 1/3 for the private sector. The data for 1978 in Denmark indicate that more than 2/3's entered the public sector. In 1976 for France the figures reveal that 75% of the arts graduates and 60% of the science graduates went to the public sector. In Great Britain 44% of the graduates in 1978 entered public administration, teaching or nationalized industries and 45% took further courses, did research or continued in academic careers. For Italy the statistics have 52% of the graduates in teaching and university work in research while an additional 14% was in other public sector employment.

The sharp drop in teacher opportunities and general decline in public sector employment in the last decade in Europe have led to exhortations to prepare for the private sector or for "under-employment" i.e. for jobs requiring fewer qualifications than the university graduate possesses. An official agency like the West German Central Federal Employment Office in Nurenberg urges graduates to lower sights. Students should be less specialized, less oriented toward a particular career -- they could, for instance, combine skilled craft work with an engineering degree. German graduates take jobs normally filled with "Abiturienten" who, in turn, enter apprenticeships formerly open to pupils with intermediate school leaving certificates.

An Italian Prime Minister praises the delights of manual labor to university graduates. Chancellor Helmut Kohl of West Germany declares the number of university graduates to be disproportionate to the needs of the labor market. He asserts that specialized vocational training is often the more sensible alternative to students contemplating university entrance. There is also the attitude of former French Minister of Education Edgar Faure, whose Unesco speech as reported in Le Monde Sept. 27, 1972 says, "I do not see any objection to the fact that a man who has obtained a degree gets a manual job; it is already a privilege to have been able to study; hence it cannot procure for those who have benefited from it the right to enjoy, forever, higher incomes and more agreeable lives."

Such pleading by political leaders has apparently had some success. A recent poll of West Germans shows that for 1984 59.2% of abitur holders want to go to the university, in 1983 62.5%. In 1972 almost 90% wished to go to the university.

The perspective is further elaborated in the work of Professor Ushiogi. He has demonstrated that graduates of Japanese higher education have been appearing in increasing numbers and proportions in clerical and sales occupations and blue collar jobs. Further, he has shown that a relatively higher percentage of graduates appearing in such occupations of average status is a common feature of societies well invested in mass higher education such as Canada, U.S.A. and Japan, while a low percentage is absorbed in those occupations in societies less deeply invested in mass higher education, e.g. West European countries.

In the first set of countries internally diverse systems of higher education have diverse connections to job markets; graduates try to adjust expectations accordingly. In the second set of countries less diverse systems have more specific connections to job markets, e.g. primarily to the leading professions and in the past to the civil service, and graduates have narrow expectations about appropriate employment.

Functionalists believe that as more college and university graduates appear as office clerks, automobile salesmen, computer science programmers, laboratory technicians, engineering technologists and occupy the ranks of advanced blue collar labor, it will seem to them and to their observers that they are not necessarily under-employed and over-educated. But in Europe they have not particularly noted the impact on curriculum, i.e. they have assumed traditional university education for these middle jobs newly available to the graduate.

Or they may cite the I.U.T.'s of France, the district colleges of

Norway, the Gesamthochschule of Germany, or the polytechnics of Great Britain as providing a more direct, relevant training for these middle-status positions. Indeed in a recessive European economy the graduates of short-cycle higher education training institutions may be competing with university graduates for the same positions.

Only in Sweden perhaps have the universities in the 1968 and 1975 reforms incorporated theory cum practice courses in the curriculum and technical-like programs in response to apparent social necessities. Plans for incorporating the following, hitherto classified as upper secondary studies, were included in higher education in the post-1968 implementation of reform: pr-school teacher training colleges, schools of home economics, physiotherapy institutions, schools of nursing, recreation leader training and occupational therapists, for example.

But even Sweden with its breakdown of all positions into five categories -- technology/administration, economics and social work/ medicine and nursing world/teaching/cultural information -- have sparse forecasting. Higher education and forecasting can apparently take place in a time of expansion. Pressure from employers/unions or universities and other post-secondary education units for forecasting and training technical/scientific personnel to fill gaps in technician supply -- e.g. shipping and oil in Norway -- occurs, but in general the educational system lags behind in responding to these needs.

Universities with their 6/7 years of training and simpler, older facilities than required may not necessarily be more adaptable. Kjell Eide points out that even before Sweden, Norway brought in vocational emphasis and avoided "tracking" in the school system because it never had the full strength of the classical gymnasium as in continental Europe or even Sweden/Denmark. Therefore, the secondary was closer to the primary level of schooling.

Other social changes also have an impact on the curriculum e.g. the age distribution of the population. The elderly have claims to the services of educational institutions. Relative emphasis on different work functions in society may alter, influencing education through gaps in the occupational structure. Some societies have more retired people than industrial workers, thus affecting attitudes toward youth and institutions.

The composition of the stock of highly qualified manpower in industrialized countries may show substantial differences in the relative strength of such groups as medical doctors, lawyers, social scientists, engineers, natural scientists. The supply of individuals with different qualifications often determined the demand.

Some nations produce a relatively high number of lawyers during the history of their universities and legally trained personnel are consequently used in a large number of functions served by other personnel categories in other countries. Again, certain nations educate large numbers of university trained engineers. These are extensively used in administration, sales and in functions regarded as technicians' jobs elsewhere.

Norway, it is said, has relatively few business economists; this lack apparently affects structure and process in Norwegian economy. Despite high density of medical doctors per capita, Norway seems to have a perceived shortage of medical doctors because its doctors perform functions satisfactorily performed in other countries by other personnel.

Professional titles may be the same but the functions performed vary considerably from country to country and educational institutions tend to adapt their training to the actual use of their candidates.

Other differences in countries may be shown by comparing average costs per student in higher education to average costs per pupil in compulsory education. The Nordic countries and U.S.A., for example, spend relatively more on education at the lower levels.

Similar differences may be noted in relative resource inputs in general education as compared to vocational education. Here also Nordic countries spend far more per pupel in vocational training than in general education.

In comparative perspective, the response to pressure by society on educational systems for vocational, quasi-professional and professional emphasis differs in Western Europe and the United States so far as impact on curriculum is concerned.

In the United States individual courses and sequences of courses are quickly devised to correspond to stated demands of accreditation societies or professions or discerned needs of local industry.
American education systems, especially in the middling and lower status higher education institutions, develop instrumental courses on "hands on" training courses to meet the demand for technolo-

gists of various kinds. Little thought is given to obsolescence, i.e. that these particular kinds of technologists may not be needed five years hence as industry or service or high technology change.

In Western European countries the curriculum itself will change only slowly but the graduate is now likely to enter the private, not the public sector, take a position once occupied by one with slighter disciplinary preparation or by a graduate of short cycle higher education.

Scandinavian countries attempt to merge theory with practice, disciplinary with instrumental knowledge, so as to retain elements of traditional knowledge, but at the same time make the student more employable in technical, para or quasi-professional positions while maintaining the customary education and training for the traditional professions.

Of course there are significant modifications of these approaches. Elite disciplinary education continues to exist in the prestigious American colleges and universities. French U.I.T.'s, Norwegian district colleges, German Gesamthochschulen, American community colleges and English polytechnics, were developed to contain the strictly technical training for employability with scant regard for general/liberal education in the curriculum. The French Grandes Ecoles and Oxbridge remain relatively untouched by these changes and their graduates continue to occupy the elite positions in their respective societies. Even Sweden, often cited as perhaps more succesful in fusing the disciplinary with the instrumental in its university system, apparently finds it necessary to reinstitute in its universities a larger role for disciplinary research, mainly deemphasized since 1968.

Yet the centerpoint in the last decade and half between the disciplinary and the instrumental knowledge, theory and practice, has surely moved toward the latter under the impact of social, industrial, and economic change. And surely the higher education graduate goes and will continue in even larger numbers to go into jobs of lesser status, formerly ignored by such graduates. And surely the curriculum in higher education institutions will reflect this circumstance slowly in Europe, more rapidly in U.S.A.

SCIENTIFIC AND TECHNOLOGICAL REVOLTION AND EDUCATION: IMPLICATIONS FOR ÇOMPARATIVE STUDIES.

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P.R.China

Scientific and technological revolution takes different forms and has different social implications under different social systems and in different economic and cultural development backgrounds. Thus, in discussing the influences of scientific revolution on education, one cannot make simplistic comparisons in isolation from the specific conditions of relevant countries. Nations of different social systems and different economic development levels should and could exchange their views and experiences in this regard. This is in the interests of international understanding and friendship, and in accordance with the requisites of our inter-dependent, internationalizing age. As for China, we need to know the outside world and benefit from all useful educational experiences while the outside world is, we believe, interested in understanding China.

We regard it a duty and a pleasure to talk about the positive and negative experiences of educational development in China. As is well-known, since the end of the internal turmoil during 1966-76, the Chinese Government has taken decisive steps in formulating and implementing long-term basic national policies of opening up to to the outside world and enlivening the internal economy. Along with the major shifts in national political and economic life, studies in comparative education are attracting increasing attention in our country, and international exchanges are developing on a wider scale. The publication of Deng Xiao- ping's inscription "Education should be oriented toward modernization, toward the world, and toward the future" has led to nation-wide discussion on education issues, and educational circles responded actively to the ideas embodied in the inscription. Not long ago the Central Committee of the Chinese Communist Party issued a Decision on the Reform of the Education System, which called for the universalization of nine years of compulsory education, the transformation of the secondary education structure, the energetic expansion of vocational and technical education, and many other reforms of strategic significance. We are convinced that, in building a highly civilized, highly democratic, modernised socialist power, the key factor is the supply of highly qualified manpower, and this manpower must be trained through appropriate education.

What are the challenges made on education by and how can we meet these challenges? What is the relationship between the revolution and education? How can the findings of the scientific revolution be applied to the field of education? Scholars not only in China but the world over are most concerned with these questions. We feel it a great pleasure to be here and to present some of our views on this issue from a comparative perspective and in relation to the situation in China today, and we cordially invite comments and criticisms from our colleagues present at this meeting.

I

The essence of scientific and technological revolution lies in the application of science in production and its change into productive forces and thereby the raising of the productive force to a new level. Science not only determines the direction of industrial and agricultural production, but also exerts great influences on education.

Thirty-five years ago more than 90% of adults in China were directly involved in agriculture and only 5% or so in industry. At present though over 60% are still in agriculture, the percentage of those in industry has risen to about 30%.

Fifty years ago more than 80% of adults in Russia were directly and indirectly engaged in agriculture and only 10% in industry. Now the former percentage is only 20% while the latter has risen to 60%, and the remaining 20% in other sectors.

These changes in the structure of social production are closely related to educational developments. According to the second national census of China in 1982, 4.417 million university graduates were trained during 1949-1982, and, if including the graduating class of 1982, the total rose to 6.02 million. Although the percentage of university-educated manpower in the whole population was only 0.6%, it was a great increase over that before liberation.

In terms of percentage of intellectuals in the work force, the field of education ranks first among all social sectors; intellectuals working in the educational field amount to 31.9% of all intellectuals in the country. At present we have 902 full-time highs education institutions, an increase of 99 over 1984, with 1.395.600 undergraduates. In addition, adult higher education institutions enrol 1.292.100. At the graduate level, there were 56.500 master's and doctoral students in 1984, and 35.000 are to be enrolled in 1985, an increase of 12.1% over 1984.

However,despite these expansions, education in China still falls short of the urgent demands of the scientific and technological revolution and the diversified needs of the economic modernization drive of the country. On the one hand, the broad masses of young people aspire to a higher education, yet they face very high competition in the college-entrance examination, the difficult situation being like thousands upon thousands of soldiers and horses competing for passing a single-plank bridge. On the other hand, China has a tremendous task in universalizing literacy and 9-year compulsory education and thereby improving the quality of the labour force. All these raise the question of how we can efficiently train the large numbers of qualified manpower badly needed by the present modernization drive and future technological society.

China is undergoing a major transformation of its educational system, with the aim of better orienting education toward modernization, toward the outside world, and toward the future, and better integrating the results of the social and scientific revolution in educational practice. We are much interested in the educational reforms going on in many other countries, for we fully realize that education has become a major global issue, that it will be quite impossible to completely solve education problems if a country tries to rely on its own material and intellectual resources in an internationalizing age of increasing interdependence, in which the development of human resources to a large degree means the improvement of education, information and knowledge.

We are therefore more interested in knowing more about theories and practices of educational reforms in other countries and about other educator's viewpoints in this regard.

In 1978 the Vice President of the Soviet Academy of Pedagogical Sciences pointed out, in his report submitted to "the Seminar on the Future of Education and the Education for the Future" sponsored by the International Institute for Educational Planning, that modern technology implies new structures in production and is paving new ways for social progress. There will be profound changes in human living and working conditions prior to the 21th century. Many studies have been made on the theme of "scientific and technological revolution and education". Much of the literature is concerned with the trends in technological development, but the influences of the technological revolution on education have not been related to social issues. In fact the positive influence of scientific revolution on education and the desirable development of man depend upon the interactions between scientific, technological and social progress and the personalization of the scientific revolution.

In 1981 Unesco organized a second seminar on "the future Development of Education". It was stated in the general report that, in discussing the complications of science and technology on education tomorrow, the concept of "science" must be interpreted in the broadest sense, that is, it must include not only precision science and natural science but also social sciences and humanities.

In 1983 the President of Erland-Nürnberg University of the Federal Republic of Germany, in his speech delivered at the International University Council held in Munich, emphasized again and again that when we put priority on technology, we should pay full attention to social and cultural development. He pointed out, "though developments in science and technology bring about great changes and promising prospects and though the rise of productivity is an essential goal for developing countries, the maladjustment of technological development to ethical values might cause a country the loss of national identity and culture and the damage of environment.

We share many of these viewpoints, and hold that scientific and technological revolution is a comprehensive and integrative process. Technological revolution means in the first place the raise of level of scientific understanding and creation but also the enhancing of human behaviour and the raising of the social development level.

The integration of natural sciences in the contemporary world has become a historical trend. Some well-known scholars in our country have always emphasized the necessity of avoiding one-sidedness and studying the issue from holistic and systematic viewpoints. Dr Qian Wue-sen, a famous Chinese scientist pointed out that we cannot take "science" merely as natural sciences, for "the formation of the productive force includes the organization and management of the production system". Since economic and social development and technological evolution influence each other and are prerequisites of each other, and since what we study is a total development strategy, the goal of development cannot be reached if due to attention is only paid to one or two aspects of development; even if some success is achieved it cannot be continued.

Many Chinese scholars, like Professor Qian Wei-chang; president of Shanghai Polytechnic University, also criticized the tendency in educational work to see material factors to the neglect of human ones. In modernizing our country we emphasize both material and spiritual or moral civilization. We put forth this requirement on the basis of our own historical experiences in building socialism in China; at the same time the phenomenon of moral decline in highly developed material civilizations of some societies has been brought to our notice and has aroused vigilance. As regards the influences of the scientific and technological revolution and their social implications, there seem to be two major schools of thought. One is "optimistic", which views scientific and technological progress as a universal, magic means of solving all social problems, or exaggerate the significance of technology and regard it as the only important factor in productivity. The other school of thought is "pessimistic", which predicts the inevitable destruction of mankind on the way technological civilization. We hold that these two kinds of ideas are somewhat one-sided. Both the positive and negative social implications of the technological revolution should be taken into account. Though we should be good at taking full advantage of the positive sides of technology, we should pay full attention to its negative effects and try to overcome them. It has become prevailing in China that science and technology are the key to our four modernizations whereas education is their foundation. Education must serve national development whereas development is dependent on education.

Therefore, in studying and trying to understand technological revolution and its multi-facet influences on social life including education, an all-round, integral evaluation and analysis should be made in close relation to the whole social process. Fantasies will not bring about a correct understanding of the nature of the scientific and technological revolution and a correct evaluation of the prospect of future development of the technological revolution and of the new possibility of human progress brought about by the technological revolution.

II

The scientific and technological revolution, together with the changes which it has led to in industrial structure and in the content and means of production, has set new demands on the quantity, quality and knowledge structure of manpower. The rapid developments of science and technology are making new challenges to education, especially to educational values and systems. Though views are diverse on issues of educational reform and the ways to implement these reforms, there is so far one point which is becoming more and more self-evident and which most people agree upon, that is, a unitary educational system will not be able to meet the diverse needs of technological revolution and national development. The educational system must be diversified, and, under conditions of technological development, students must be trained to develop adaptability, creativity and other capabilities. These cannot be achieved by increasing the learning load or prolonging the length of study. While making a series of reforms, more opportunities must be provided for second-chance and third-chance education, thereby gradually making the whole society a learning society. This process will involve many changes in educational ideas and values and corresponding transformations of educational systems, content, and methods.

Futhermore, education itself is a system in which every kind and level of education relies on the coordination of all levels of education for its full functioning. In China, the development of primary, secondary, and higher education was unbalanced. On the one hand, curricula in secondary and primary schools have not been kept up to date to new advances in science and technology; on the other hand the structure of higher-education and programmes are not in accordance with economic and technological development needs. That's why we are making major transformations and reforms in our educational system.

If we examine the history of educational development in the Third World countries after the Second World War, it can be seen that there have been two major strategies in dealing with the internal relationships within the education system. One of them is giving priority to the development of higher education and, to a lesser degree, secondary education, while the other is giving priority to universalising primary education. However we notice that many developing countries, though facing a tremendous task in promoting basic literacy and primary education, lay more stress on secondary and especially higher education. The reasons for this might be two-fold. First, there was a prevailing idea in the 1950s and 1960s that the more education an individual had, the more easily he/she could find a job, especially one which was not accessible to those with less education, and therefore the higher the economic benefits of education to the individual. Thus people demanded more and higher education, leading to an increasing social pressure for more higher education. Today , as stated in the book Education Today for the World Tomorrow by Charles Hummel, people notice that, generally speaking, the shortage of qualified manpower is still a factor impeding their development. The over-development of higher education in some developing countries which still have an urgent task in universalising literacy and primary education is not based on the demands of economic and technological development in these countries but is the result of the governments' concessions to the social pressure for more higher education.

Secondly, it is often thought that higher education has greater social economic benefits than secondary and primary education, and therefore many authorities are more willing to develop higher education. However, a number of existing studies show that primary rather than higher education has more social/economic returns. The conclusions derived from these studies would mean that the above-mentioned educational policy should be reoriented and the priority of development for developing countries especially shifted from higher to primary education. Unfortunately the Third World is not progressing in this direction.

It is evident that, in comparative studies on the new demands for manpower set forth by the technological revolution, attention should be paid to distinguishing practical experiences of other countries from objective laws governing the development process. Although the technological revolution has put new demands on manpower needs, it will be groundless to regard the expansion of enrolments and graduates of higher education institutions as the main necessity made by the scientific and technological revolution. Similarly it seems oversimplified when some study reports in our countries propose a fourfold expansion of college enrolments merely because the gross national product is scheduled to be four-times as high by the end of this century as that in 1981. We hold that integral and systematic thinking should also be applied to this kind of issue.

In light of the situation in China and the findings of relevant studies abroad, it seems that, in discussing the demands put forth by the technological revolution on manpower, it is more urgent and important to give priority to the adjustment of the structure of specialised education programmes and of multi-level manpower than overdue stress on quantitative expansion.For example, in the field of forestry, China has graduated only over 90,000 college students since its liberation in 1949. According to statistics of the Agriculture Ministry, China has 1,490 million mu

(9.93 million hectares) of cultivable land, 1.830 million mu (12.2 million hectares) of forest, and 3.300 million mu (22 million hectares) of usable grassland. Accordingly there is only one college graduate in the field of agriculture for every 6.000 mu (400 hectare) and one in the forestry for every 45.000 mu (3.000 hectare)of forest and usable grassland. In the field of finance and economics, China had only over 40.000 college graduates in 1979 while there were 400.000 factories, mines, and other enterprises. This means that on an average for every enterprise there is less than one college graduate in the field of finance and economics. These statistics illustrate the maladjustment in specialised education programmes. In terms of levels of manpower education, there also exists in China a maladjustment of mid-level and high-level personnel because of the slow development of secondary technical education. According to the National Statistics Bureau, there are more college graduates in fields of engineering than those from secondary technical schools. Many facts have shown us that the wastage and loss resulting from the above two maladjustments were not less than those from the shortage of qualified manpower. That's why it has become an urgent task for us to adjust the ratios of manpower of different fields of study and at different levels.

Along with increasing information, most countries are paying more and more attention to applying information technology in schools. Statistics showed that in 1983 in the USA there were one or several micro computers in 85% of senior high schools, 77% of junior high schools and 62.4% of primary schools. About 30% of schools made use of computers in instruction. In Britain, 5.500 secondary schools have been equipped with one or several micro-computers, and more than 50% of primary schools have had computers. The Government of France is planning to popularise computer education in senior high schools by 1986 and in junior high schools by 1988. In Japan some secondary and primary schools have been selected for experiments in extra-curricular computer education. In the USSR instruction in computers will be begun in the 9th grade from September 1,1985.

In recent years China has also been active in promoting modernisation of instructional technology. The progress in this respect is more obvious in large cities such as Beijing and Shang-hai. For example in Shenzhen High School "computers" has become a compulsory course for all senior high and some junior high students. The school purchased 40 computers and allocated 5 full-time teachers for the instruction of that course. There are three computer rooms, one language laboratory, and one video-recording room. The students devote two periods to the course every week, one for theoretical instruction, and the other for practice.

III

In exploring educational aims, content, methods and technology, and relevant models for tomorrow, nearly all countries take the needs of the "information society" as a guiding principle.

In building a modernised socialist country, we fully realise the significance of understanding our national conditions. Our goal is to establish a socialist education system with Chinese characteristics. While we observe the objective laws of the educational process itself, we will pay close attention to world trends and adapt experiences of other countries to Chinese conditions. From our own experiences, the development of education is not only a response to the needs of technological revolution but mainly a reflection of the development of social productive force and the changes in social relations. The challenges facing education are mainly the information explosion of scientific knowledge and the changes in economic and political life. The essence of these challenges lies in whether education can train qualified manpower of appropriate quantity and quality in accordance with the needs of national development.

As regards this issue we would also like to present some of our viewpoints for the comments of experts and scholars from other countries.

First, one fundamental change in education is that of educational ideas. Since industry, agriculture and commerce, based on new technologies, are knowledge-intensive, the future society not only needs a large number of experts, but also demands of ordinary workers the combination of physical labour with mental labour. Therefore basic education should be further strengthened while attention is paid to the necessary development of higher education. There should be a diversified multi-level, multi-format system of education.For this system to be fully functioning there must be relevant changes in people's outlook on education. As in our country, there are still some people who emphasise production to the neglect of education and science. Therefore the leaders of our country stress the necessity again and again of valuing knowledge and talents.

Secondly, no matter how rapid the technological innovations are, people will have the necessary adaptability to adjust to the changes in technology so long as they have a solid, sound education in basic knowledge and solid training in basic skills. It is a one-sided, wrong view that in a technologically developed society it is necessary only to learn math, physics, and chemistry, not social sciences and humanities. It goes without saying that the number and content of basic courses are always changing. In view of the needs of social and technological development, new advances in science and technology should be incorporated into curriculum and textbooks, those out-of-date or minor materials omitted, and new courses added or new implications given to existing disciplines and courses. In addition to "electronic computers" as an additional feasible compulsory subject in secondary and primary schools, foreign languages should be given more importance, for production in a technologically developed society production is often international in nature and the open-door policy of our country also demands better learning of foreign languages for a better understanding of social, economic and technological developments abroad.

Thirdly, in order to adjust to the drastic increase in knowledge and rapid change of technology, the personnel needed by the new age must be capable of processing a large amount of information, that is, continuously and independently collecting and communicating information, and making innovations. Many secondary and primary schools in our country are organizing various extracurricular activities of out-of -school activities, which are called in China "the second classroom" or "the second information channel".

Fourthly, the "information society" demands that teaching, research, and production in universities and colleges be made into "allies". The over-emphasis on basic research in academies and the artificial divorce of basic, applied, and development research are increasingly challenged by the scientific and technological revolution. Practice has proven that it is both feasible and efficient in our country to establish and develop various forms of "combinations" or "allies" of teaching, research, and production between higher education institutions and industrial enterprises. In recent years "research-production entities" in China have made new developments. Statistics show that in 1983 more than ten universities and colleges set up thirty "teaching-research-production entities". Since the Patent Act was effected in April, 1985, universities and colleges which are under the direct administration of the Education Ministry have obtained patent rights for 629 technological inventions and innovations, amounting to 24% of all patents in our country. The application to production of research carried out in these institutions in recent years has brought large amounts of profit. There were 153 research projects, each of which resulted in more than one million yuan of annual economic return, and 40 projects among them each produced over 5 million yuan, totalling 810 million yuan of profit. This year these higher education institutions can recommend 1,912 items of technological innovations to 13 occupations.

Fifthly, it should be stressed that technolocal progress cannot by itself bring about fundamental changes in social values and ethical ideas. The problems of drugs, violence, and crimes will not be eliminated due to technological advances. We are aware that, when in the process of social, economic, and technological development in a socialist system, we must be on guard against the phenomenon of "spiritual poverty in an abundantly rich material society". One basic principle in our educational reforms is to lay the stress on both material and spiritual civilisation and to train the young generation to be good citizens who have lofty ideals, high morales, solid education, and are disciplined, and who love their motherland and the socialist cause, are dedicated to the prosperity of the nation and the welfare of the people, and are enthusiastic in pursuing new knowledge and courageous in making inventions and innovations. What we are striving for is a higly developed civilization with education as its solid foundation and technology as an efficient means.

Part. III

Closing speech

Reports working groups

General report

NEW TECHNOLOGIES AND EDUCATION - LESSONS SO FAR

NOUVELLES TECHNOLOGIES ET EDUCATION - QU'AVONS NOUS APPRIS JUSQU'A PRESENT?

CLOSING SPEECH*
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Monsieur le Président, je vous remercie beaucoup cette aimable introduction. Laisse moi dire d'abord que je suis très honoré de présenter cet exposé à la fin de vos discussions. Je vais essayer de vous faire part de quelques réflexions au sujet des nouvelles technologies de l'information, de l'enseignement et de l'éducation telles qu'à mon avis elles se dégagent d'un certain nombre de travaux de mon institut et de quelques autres organisations notamment des organisations internationales telles que le CDEU, Conseil d'Europe et la CEU. Quel sera plus précisément le sujet de cet exposé? "Nouvelles technologies de l'information et éducation: qu'avons-nous appris jusqu'à présent?", "New technologies and education, lessons so far" (avec l'accent sur jusqu'à maintenant). Et surtout quels sont les résultats d'une approche comparative. Ce sont surtout les travaux comparatifs de mon institut et de ces autres organisations internationales auxquels je voudrais me référer. Je crois que l'approche comparative est ici un instrument particulièrement utile, sinon particulièrement important, parfois même le seul en vue de l'évaluation et de la définition des politiques appropriées dans ce domaine précis des relations, ou de l'introduction des nouvelles technologies de l'information dans l'enseignement. Pourquoi c'est un intrument tellement important, tellement utile? Il y a plusieurs raisons à mon avis, tout d'abord, parce qu'il s'agit d'un domaine nouveau, et en même temps très mouvant. Un domaine plein d'incertitudes, dont je parlerais à la fin de mon exposé. L'approche comparative permet non pas d'éliminer ces incertitudes, mais peut- être de les réduire au moins un tout petit peu et de dégager certains paramètres ou certaines tendances lourdes qui en quelque sorte déterminent ou conditionnent la bonne insertion, si au moins il y a une bonne insertion de nouvelles technologies de l'information dans l'éducation et la formation. Pourquoi, encore une fois, c'est que souvent on peut pas attendre puisque c'est un domaine tellement mouvant. Puisqu'il y a un tel intérêt dans ce domaine, on peut pas s'attendre à des évaluations approfondies qui normalement devraient conditionner une révolution ou une réforme aussi importante que l'introduction de ces nouvelles technologies. On devrait pas attendre, et seul je crois la comparaison de ce qui se passe de parts et d'autres, constitue un raccourci en quelque sorte, justifié pour définir un certain nombre de forces en présence, un certain nombre de forces qu'il faut tenir compte. Quelques exemples. Lorsqu'on regarde dans une perspective comparative ce qui se passe dans le pays et surtout lorsqu'on regarde la formation, le déroulement, la mise en vie, la mise en oeuvre des différentes politiques nationales, dans ce domaine on voit de plus en plus claire l'importance stratégique de la formation des enseignants à travers cette approche comparative . On voit aussi quelques éléments-clés de la relation formation aux ITI, nouvelle technologie de la formation emploie, c'est à dire, la relation en tant l'éducation, l'enseignement et la formation à ces nouvelles technologies et la structure de qualification qu'impose en quelque sorte les marchés du travail. On voit aussi ça troisième exemple, les avantages et les inconvénients de différentes politiques, ou si vous voulez, de différentes priorités que ces politiques accordent, attribuent dans ce domaine aux différents secteurs de l'enseignement. Car presque partout se pose la question par où faut-il commencer, faut-il commencer, faut-il porter notre effort principal, nos ressources les plus importantes dans l'enseignement primaire, dans l'enseignement secondaire, dans la formation professionnelle, même dans la formation supérieure de haut niveau. Une question très importante, et on ne peut pas s'attendre à ce que le résultat se manifeste dans chaque pays à partir de ces résultats révisé le politique, mais on peut dès maintenant voir ce qui se passe, les avantages, les inconvénients à commencer par le secondaire comme on a fait dans la plupart des pays ou de commencer par la formation professionnelle et ainsi de suite. Voilà la remarque préliminaire, donc l'importance de l'approche comparative et souvent même l'importance stratégique de cet outil. Je voudrais maintenant poser une question et discuter un peu les possibilités des réponses à cette question. Est-ce que la relation, entre les nouvelles technologies et éducation de la même nature lorsqu'il s'agit de nouvelles technologies de l'information, avec l'accent sur le mot information, c'est-à- dire micro-éléctronique, et pas seulement l'ordinateur, mais aussi les nouveaux médias, les ressauts de câbles interactives, le vidéo-disque etcetera, toutes ces nouvelles technologies de l'information, est-ce que la nature de la relation entre ces technologies est l'enseignement d'éducation? Est-elle de la même nature qu'étaient les relations entre nouvelles technologies et éducation dans le passé? Voilà la question que je me pose. Je crois qu'il y a au moins trois raisons, pourquoi cette relation est peut- être jusqu'à un certain point d'un type nouveau. Et j'appellerai ces trois raisons, économique, pédagogique et sociologique. Commençons par la raison économique. Les nouvelles technologies de l'information les inXX, et ceci est nouveau, sont à la fois un outil et un objet d'apprentissage. On utilise ou on veut utiliser les nouvelles technologies de l'information pour améliorer le rendement qualitatif et qualitatif de l'école. Mais on les utilise également et souvent en premier lieu parce qu'il y a une demande insatisfaite de formation dans le secteur économique, produisant les nouvelles technologies de formation. Mais pas seulement produisant, également utilisant. Presque tout le secteur économique d'aujourd'hui, c.à.d les producteurs, les fabricants des ordinateurs, mais aussi toute l'industrie souvent même l'artisana et tout le service, la banque, l'assurance etcetera, tous ceux utilisent et utiliseront de plus en plus les nouvelles technologies de l'information et de la communication. Par conséquent, du point de vue économique il apparaît indispensable d'introduire la formation à ces nouvelles technologies dans presque toute la formation et comme un élément constitutif du processus d'éducation souvent depuis l'âge ou depuis l'école primaire. Ceci certainement n'était pas le cas avec les autres technologies. Prenons le cas de la télévision. On dit souvent que l'école a raté la révolution de la télévision. C'est probablement vrai, mais en tout cas dans la mesure où on a introduit ou voulu introduire la télévision à l'école; c'était essentiellement comme un instrument de transmission, de connaissance ou outile pédagogique, en bref, ce n'était pas comme un objet d'apprentissage entendu, dans quelques écoles tout à fait spécialisées, comme le journalisme ou l'électronique. Avec les nouvelles technologies de l'information, tout le pays, le gouvernement, les spécialistes inclus pense à tort ou à raison que leur survie dépend de plus en plus de l'avenir du développement des industries fabriquant les nouvelles technologies de l'information et de l'utilisation de la modernisation des anciennes industries à l'aide des nouvelles technologies de l'information. Par conséquent la survie dépend aussi de la façon dont les jeunes ou les adultes de ces pays sauront les comprendre, sauront les utiliser. Voilà la deuxième différence, à mon avis, entre les anciennes nouvelles technologies. Deuxième raison enfin, pédagogique. Ici la réponse, encore une fois à tort ou à raison, est relativement simple. On dit que pour la première fois les nouvelles technologies de l'information sont interactives à une grande échelle. Leur promesse est beaucoup plus grande, leur potentiel est infiniment plus grand que celui des anciennes nouvelles technologies. Pensons à l'enseignement à distance, pensons au problème de la créativité, tout ça est lié au concept de l'interactivité qui lui-même est lié aux nouvelles technologies de l'information. C'était la deuxième raison, première économique, deuxième pédagogique. Troisième raison enfin, raison sociologique souvent un peu négligé peut-être, mais très puissante. La pression derrière l'introduction des nouvelles technologies de l'information et aussi la récompense qui plus ou moins en suit est extraordinairement importante. Elle est infiniment plus grande que tout ce que nous avons connu dans le passé. Regardons toutes ces conférences, tous ces projets des organisations internationales que j'ai mentionnées. Le OCD depuis plusieurs années a un programme et a eu plusieurs conférences, le Conseil de l'Europe a eu plusieurs conférences et un programme extrêmement important au sein de la commission Européenne à Bruxelles etcetera. Encore plus importantes sont les politiques nationales. Au moment où les budgets d'éducation sont en diminution presque partout on lance de nouveau de grands programmes d'équipement ou des grands programmes d'introduction des nouvelles technologies de l'information à l'école. L'informatique pour tous, le plan informatique pour tous en France, le EEP MEP, Micro-electroniques education programme en Angleterre, le "Simulierungs", le plan de stimulation au Pays Bas, et ainsi de suite. Mais considérant les réductions budgétaires un peu partout ailleurs c'est assez extra-ordinaire que ces nouvelles technologies bénéficient des sommes relativement importantes. Un inspecteur britannique m'a raconté qu'il existe dorénavant des écoles en Angleterre, dont les murs ou la peinture du moins s'écoule, mais qui ont toujours l'argent pour acheter des ordinateurs. Et tout le monde connait les écoles ou les universités qui n'ont pas d'argent pour engager de nouveaux enseignants, mais qui trouvent toujours quelque part de l'argent pour acheter deux ou vingt micros. Cette pression signifie évidemment en même temps que les résistances sont moindres, chez les acteurs principaux en faite pour la première fois on se trouve devant une situation où les nouvelles technologies sont acceuillies dans l'éducation avec empressement par les acteurs principaux, c'est à dire premièrement par les élèves, et on parle des élèves qui sont obsédés par l'ordinateur, qui utilisent tout leur temps libre pour allez à l'école, qui créent des claps, samedi dimanche etcetera. Beaucoup de programmes d'informatique dans les écoles ont été gérés par les enseignants qui ont travaillé encore une fois sans être rémunérés pour ces tâches supplémentaires et ainsi de suite. On est donc confronté avec une situation qui est presque le contraire de ce qu'on connaissait avant. On parlait toujours de la résistance, aux nouvelles technologies tandis qu'ici se présente cette situation extrêmement favorable. Evidemment on peut dire que tout ça est une mode et que tout ça est un "fact" comme disent les anglais, une mode qui passera un jour comme d'autres modes sont passées. Je ne sais pas si c'est vrai, mais peu importe, car cette pression et cet acceuil sont relativement favorables, malgré le peu de résistance. Il s'agit d'un fait sociologique capital que l'on ne peut certainement pas nier. Les statistiques forment la preuve de la force de ce phénomène, de la puissance, de la pression et de ces climats relativement favorables. Prenons p.e. la France où cinquante huit lycées ont été équipés au début des années soixante-dix. Vers soixante-dix-sept on parlait de l'achat de l'équipement des écoles avec dix mille micro-ordinateurs, quatre ans plus tard, on parlait de cent mille micro-ordinateurs et aujourd'hui on est à peu près à deux cent vingt mille. Il existe dorénavant des universités où on espère d'avoir bientôt un micro-ordinateur par étudiant. Ce sont des exceptions mais le cas typique à Pittsburg, mais même en France, je trouvais une grande école, le HEC, où on espère d'avoir un micro-ordinateur par élève à la fin de cette année ou l'année prochaine. Voilà donc une preuve de la puissance de ce phénomène, justifié ou non. Peu importe, c'est la pression, le fait sociologique qui compte. Et maintenant je passera à l'anglais pour un peu équilibrer. In other words I will switch to English now. In this second part I want to discuss what we learned during these first five or ten years. It is less than ten years since the new information technologies became one of the major facts in national policies and even in individual schools. It would of course be absurd to draw in a few minutes all the lessons or to record all the mean research results in this respect. And anyhow there are not many really true research results. So I'll just try to list some key points. Lesson number one, almost trivial, is the complexity of the whole process of introducing an idea into education. In this respect many of the old findings concerning for example a relation between education and TV still hold, in spite of the three reasons I mentioned before: the economic, pedagogical and sociological ones. What holds and what is still true and maybe even more than in the past, is in particular the fact that everything depends on the multiplicity of interactions between technological developments and social, economic individual behaviours on the insertion, in other words, of the new technology into a broader educational context. This finding, concerning this multiplicity of reactions already lead to some results. If you look at the very new policies in the field of NIT and education, and compare them with those of the late seventies, only five years ago, you will find rather easily that there is a trend away from what some people might call the hardware approach or the exclusive hardware approach in policies, buying of the good computers. A trend away towards

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*: printed text is a transcription of the conference room recording

emphasis, on teacher training, on quality software production. Programming or teaching children and teachers to program in Basic or in another language is not important anymore. There is a greater consciousness that human and social factors are becoming absolutely essential. But more than teacher training or quality, software is really involved and maybe that in this respect we have not yet reached appropriate conclusions or drew appropriate consequences. What is needed is probably the rethinking of the whole role and place of the school and of the teacher within the whole range of learning opportunities, which - with the NIT or thanks to the NIT - has considerably increased. We can expect either spontaneous or deliberate shifts in learning locations, school and home, school and working place, and so on. The climate of the future classroom and sometimes already of the present classroom where traditionally you had only two main actors, the pupil and the teacher, is now a climate with three main actors and will be more and more so. Three main actors: the teacher, the pupil and the machine, or the new media, which obviously changes completely the situation of the teacher and which obviously creates new training requirements. So the shift which we are now witnessing in certain countries, is the shift from training-devices or training-schemes, which in the past emphasized which you might call the hardware approach. Handling of the computer or micro-computer towards training, which will prepare the teacher for his new role. I'm shifting from technology to pedagogy now. In the last respect just one example. It was realized in France, that the teachers who somehow can handle best the new situation in this new climate of the classroom, where individualized learning becomes easier, are those who have an experience in rule and classroom schools. Because they got used to handling groups of children of different ages. So you are somehow in a similar situation today but with of course quite different conditions. What needs of course also rethinking is the whole division between the whole traditional divisions of the education system, between general and vocational education for example, or and especially, between initial and continuing education etcetera. Now all these if you want are old problems, they existed before the NIT's came in, certainly already in the sixties if not earlier. But the new technologies, putting new emphasis on these problems, so that hopefully teachers today and hopefully policymakers tomorrow, are much more conscious of this need for some fundamental rethinking. Second lesson: the multimedia concept. It is now clear to the extent that evaluations about the efficacity or the effectiveness of the new information technologies exist. It is clear from these evaluations that NIT alone, micro-computers alone, will not suffice. It will not have the desired or expected effects. The best results were achieved in cases where you had a combination between the new media and new information technologies and old media or old new technologies if you want, such as television, radio, or even much older ones, such as correspondance. An example here is the open university in the United Kingdom. Third lesson: the original dychotomy between new information technologies or computers as a tool, as a pedagogical tool and as an object of learning, is now more and more bleared. Five years ago there was a big dispute between those countries which introduced new information technologies into education as a special subject to be taught to people and others which tried to introduce it as a dimension in every subject and especially as a pedagogical tool. By now it is more and more recognized that it is complementary and that they are somehow very often almost identical, in the sense that often you learn about the computers best by working with the computer, even if it is let say in history or in a language teaching. Forth lesson. Training for new information technologies and employment. In most countries now three types of training for information technologies emerge. First category are the specialists, top-level or middle-level, whose training- course - is entirely devoted to the problems or to some aspects of new information technologies. They will be the people working on them, reparing, producing or designing them, etcetera. Second category are the NIT specialists, which Mr. Plomb called "appliers" and which in France you call "specialistes à double compétence". They receive of an important part of their training and education concerning NIT's so as to be able not only to use them but to introduce them in their specific jobs. Third category are the simple users, in other words the people who should know about the computers. And they should not only know how to handle them, because maybe this is the easiest thing. It becomes obvious that this possibly shouldn't even be done in school because it can be learned on the job within a very short time. They should get a training, which concernes somehow a knowledge about what the computers can do and what they can't do, what limits there are, what dangers they imply and so one. Quantitively it is often assumed that there are deficits in all these three fields. The fact is that the number of specialists, which are to be trained, top-level specialists in this field, is probably much smaller than what is usually expected. It is now quite clear that the largest number of people who are needed, are those of the second. They are the people who are not to be top-level specialists, but who have sufficient knowledge to introduce NIT. As far as computer-literacy is concerned, everybody agrees that this is now an element of the general culture. Unfortunately there is still no agreement on what the content of this computer-literacy is. There is a trend away from the purely technical training towards more training concerning the potential use and limits of the computers. Fift lesson: forecasting, especially quantitative forecasting of manpower needs concerning NIT's, is very problematic for many reasons: data are missing, there is no comparability between the data from one country to another, so comparative educations can't help to much in this respect. There is a lot of uncertainty about the technological developments, because we don't know enough about the future man-machine relations. Therefore we don't know what type of specialists really will be needed which has consequences for the training and so on. Curiously enough, in spite of these difficulties and maybe in spite of the meaninglessness of any forecasting concerning these needs, you always have governments, international organisations, who ask that such forecasts are being made. And they are being made, but it leads to completely contradictory results. In France you have a famous report which was produced already in 1979, which speaks of about 150.000 who would be needed. I met a director of one of the largest European computer firms, who told me that, when he is being asked by his friends and relatives what kind of training he would recommend to his or her children, he always tells them: everything except computer-science. And this was said by a computer scientist. So you know there is such a disagreement: policymakers and educators are in a very difficult situation when they should decide. An example of how this is difficult and why in fact these forecasts are so arbituary. Those of you from Britain or from other countries know PRESTEL. This is a system providing communication services at home and so one. When PRESTEL was launched in 1978 it was forecast that by 1984 there would be one million subscribers. By 1984 there were forthy thousand subscribers. And nobody knows why, but certainly not for technological reasons. There were some social reasons which made the technology acceptable and others which made it to be rejected. In France on the contrary, you have TELETEL, which is the French equivalent to PRESTEL. TELETEL has by now, although it was started one or two years later than PRESTEL, seven hundred and fifty thousand subscribers and yesterday it had to be closed down because of overcharge. So two technologically exactly the same things and they developed completely differently. Sixth lesson. More research is needed on the social interactions involved. There is a growing consciousness that this problem of the social interactions in connection with the technology is something terribly important and that we don't know enough about it. There is a new project about the technology acceptability, and there are a few other studies, but by far not enough, because that's the problem which will also influence education. There's a study that we have been doing in my institute in the past about the problem of implementation of reform. I think one of the key problems in this field is indeed the problem of implementation, of carrying through a given policy of the various perverse, unexpected effects which it has. Seventh lesson: the technology diffusion is always a long process, even for the NIT's. A British study of some years ago, by Freeman, shows that the average duration of technology, of general diffusion of a new technology is thirthy years. Now you would expect that with the new technologies this is being shortened. I've recently read a study produced in 1965 by the International Institute of Educational Planning on airborn television in the United States. And the subtitle of this study is the first step to educational satelites. Well, we are now twenty years later and I can't say that educational satelites is a common thing in our education system. It will be there surely, and it will probably be close to thirty years or at least twenty five years. Micro-computers started in the early seventees, so they are there, but before it really becomes a "fait sociologique" in all the French, German, or English schools, it will probably be again twenty years, maybe a bit shorter. Final point the problem of uncertainty. The uncertainty of the process of insertion of new information technologies into education is something inherent. I think we should reuse it and the comparative approach, as I tried to show you, helps in this respect. But we will never be able to eliminate it completely and therefore somehow we have to be able to face it or increase the capacity of facing the uncertainty. Probably there is only one category of solution and this is evaluation of on-going trends and of experiments launched. But maybe more important than evaluation, is the use of the results of the evaluation to correct the original policies or plans. This, of course, poses the difficult question of the desirable relation between the researcher and the policy-maker and also the implementor. But this, of course, would be a subject for another conference. Conferences about it took place. Therefore I can only conclude by saying I feel that in this respect comparative research on NIT and education can make an important contribution.

REPORT WORKING GROUP 1.: RELATIONSHIPS BETWEEN: TECHNOLOGY, LABOUR RELATIONS AND THE LABOUR MARKET, EDUCATION AND SCHOOLING.

Group coordinator: D. Kallen

Rapporteur: Botho Von Kopp

Let me give, before starting with the reports some short notions to the beginning. It's like a summary ahead, there is only one thing we know definitely as for the present and future relations between school, education, technology and labour market. We don't know anything definite and there are many contradictive forecasts as for that. Nevertheless we should preserve or perhaps develop a moderate optimism as Prof. Mitter called it and I think there are good reasons for this. Not that there are no problems, but we all strive for coping with them. Last but not least such exchangements of views, experiences and informations, as we had on behalf of this conference and the working groups, are part of our work to come closer to the understanding of the character of those problems. Presenting this report I even do not try to cover the wide range of all this single contributions we had in our group. I probably would disappoint those whose contributions have been shortened, taken out of the context, or could not have been taken into consideration in a short report like this at all. I decided instead to be more democratic and to disappoint all, undiscriminatingly by giving a rather personal summary. I structured my report into three sections, following the team of our work group. So the first is technology, than labour relations and thirdly labour market, all in relation to education and schooling.

First technology. Of course it's still more disappointing, I prepared a paper and I found now that Prof. Cerych sead much what I wanted to tell and much more of course and better so I ask you forgiving me repeating some issues he told already before, please give me the opportunity to tell what I had prepared. There are and there will be some short and some long living changes in technologies and probably as it was until now technologies of very different stages of development. Archied, premodern and modern ones will coexist at the same time. We even faced changes in the exchangeable value of products, produced with different technologies. In a time in which the production of many goods became relatively cheap and the worker freed of the respective hard manual work, the same products if they are handmade become much more expensive and often even highly prestigeous. The implications of the so called new technologies, however, bring about modes and means of production very different from those of the big machine age with his transformations of a multitude of various raw materials in a long chane of structurely different processings. A process, however, of direct control of unequivocal relationships. In a way the processing and production of information is very different as far as the sciences and theories on which information technology is based, are concerned. So I'm not talking at the moment about the tools, but the underlying principles. Basic research for the more sophisticated information technology is looking for ways of knowlidge processing which come near to thinking processes. Clearly the search processes can not be reached by a massing of storage capacity only, but algoritms with free and risky choice intersections. In other areas such as the envisioned biologically organic production some decisive fases are black boxes for the producers themselves. In short, these new technologies imply highy diversified, indirect and partly non-deterministic modes of control. All this implies also, as I think, the adaptation of new values and attitudes, which possibly will spread also into social live.

Before coming to the second point, before coming to labour relations, I should like to point out the necessity for educational science to reflect its attitudes towards human labour generally. Is it a curse imposed on man, perhaps a transitional one, we just are waiting for the tools to secure us the paradise of leisure time, or is it a central and tropological factor of human self identification and consciousness, individual as well as collective? The problem seems to be that it is not exclusively the one or the other. But if we agree, it should become increasingly the latter than the individual should be given the preconditions and conditions of expressing in their work and in interaction with others the aims which were reflected by them and are meaningful for them. Again I think education has to play an important role in this point. Here, of course, so it is a permanent challenge for education, permanent because technologies change. Can we expect that the new technologies will give way to less alianate labour relations either directly or indirectly. I am a bit sceptical about our expectations of a service society. My impression, and this was also told several times mentioned in our discussions is, lets learn from others, that some services are even deteriorating at the best become more bureaucratic. As for that, I found during my research in Japan, were the service sector is surely developed at least as impressingly as is the producing, that it is very difficult to promote at the same time work and leisure ethics in their traditional meaning. New technologies and service by information society or post industrial society or whatever you name it, will not do away with alienation automatically, rather there could emerge new, more indirect forms and contents of alienation connected with labour. It was often pointed out that the development of technology makes vanish more and more hard fysical work, and even increasingly diminish the time to be devoted to work. But I hope we agree that we did not free our capacities in order to become a mere consumer society. The new possibilities mean however that one has to redefine the meaning both of labour and of leasure and again this is a challenge to education.

As for the impact of new technologies on the labour market, both in their material and non-material aspects, we were sure in our intensive group discussions only for the fact there is an intolerably high rate of unemployment in most European countries. That its reasons are highly diverse and effect various groups of professions and persons differently and that there are no realiable motives of predictability at all. At least not the predictability which could be derived from some inherent and causal, logical interrelationships between the technological development, school education and labour market. We discussed various aspects of the function of school and educational reform strategies in different countries, respectively what kind of education, a more vocational, a more general, a longer schooling or the distribution of education in different fases of live along learning and alike. We however overall agreed that trying to catch up with every new change in technology is not very desirable nor rational. After all it was trust it is not school that causes unemployement. On the other hand this does not mean that school can be indifferent to this problem. It was mentioned that in Japan school provides above all general education, various implant training gives actually needed skills and facilitates a training on the job. That means there were changes in technology take actually place. For similar reasons and other reasons the otherwise very different German system of combined schooling and apprenticeship seems to be an attractive model for some foreign educationalists. Altough I can see great advantages especially in the Japanese model, which aims at giving all youth a very high level of general education, it is by no means free of problems. For example, truly it stimulates flexibility and the content of professional qualification, but restricts in a way the mobility and the labour market. There are more, but this is just one example I would like to mention, above all however, the respective advantages and disadvantages are inbedded in the different political, economical, social and cultural contexts. Their neglectance and the search for quick solutions often provoces some educational politicians, and perhaps it's not wrong when I see also ourselves sometimes as educationalists to repeat the mistakes of our neighbours, neighbour countries or by transplantation of his advantages to create new problems in our own country. This happens often enough in the very moment when he lookes at our system ready to try a new remedy. I want to close this and the last sentence is not ment at all to be a pessimistic outview but an appeal to continue in comparative research.

REPORT WORKING GROUP 2.: NEW TECHNOLOGIES IN THE LEARNING PROCESS

Group co-ordinator: Prof. M. Laeng

Rapporteur: A. Louwyck

La deuxième commission de travail, sous la coordination du professeur Laeng (de l'Université de Rome), s'occupait des nouvelles technologies dans le procès éducatif.
Nous avions une douzaine de rapports, à présenter par des chercheurs, comparatistes, professeurs ou rapporteurs de Belgique, de Hollande, de France, d'Espagne, d'Italie, des Etats-Unis et de Canada.

- Monsieur Wasser des Etats-Unis (The City University of New York) commençait par un rapport de sa recherche comparative entre l'Europe et les Etats-Unis cencernant les programmes d'études ("instrumental versus disciplinary curricula). On constate, depuis une vingtaine d'années, une évolution vers la connaissance instrumentale. Du point de vue des programmes d'études, et surtout dans l'enseignement supérieur, l'Europe s'y préparerait plus rapidement que les Etats-Unis.
- Ensuite Monsieur Mabin Viadel (Madrid) présentait un rapport concernant l'emploi de l'ordinateur dans les beaux arts. Après son introduction plusieurs membres du groupe témoignaient des expériments dans quelques académies ou facultés artistiques, inclus dans celle de la musique.
- Monsieur Valke du département de pédagogie expérimentale de l'Université d'état de Gand (la Flandre) donnait une introduction du système LOGO dans l'enseignement primaire. Il ajoutait que pour l'intégration dans les programmes d'études des écoles primaires (par exemple dans les mathématiques) il faut une adaption du système LOGO. Pendant la discussion on constatait dans presque tous les pays des besoins dans le domaine de la formation des instituteurs et institutrices. Il faut par exemple que l'enseignant connaisse mieux l'usage pratique de la machine et les alternatives dans l'écran.
- Monsieur Lancy de l'Université d'Etat de Utah (les Etats-Unis) présentait cinq modèles ou systèmes pour l'usage de l'ordinateur dans les écoles maternelles, primaires et compréhensives (the middle school in the U.S.A.). Il parlait par exemple avec enthousiasme de l'introduction d'un coin d'activité ("the activity corner"). Les enseignants sont très intéressés à ces

coins, parce qu'ils sont flexibles. Les enseignants connaissent aussi d'autres activités en classe et ils proposent la possibilité d'introduire systématiquement les autres systèmes, par exemple le système "tutor", "the computer assisted instruction", "LOGO", "Problem solving", etc.

- Le mercredi après-midi nous nous étions concentrés sur deux introductions sur l'emploi de l'ordinateur dans les facultés de psychologie et de pédagogie pour nos propres étudiants.
  La première était de Madame Van Den Brande de l'Université Libre Néerlandophone à Bruxelles. Elle présentait son travail à l'aide d'un instrument (plutôt individuel) pour analyser et diagnostiquer des problèmes de psychologie sociale et plus precisément pour établir la prévision de la conduite des autres.
  Cette introduction était suivie d'un rapport de Monsieur Herrero Diez de l'Université d'Oviedo (l'Espagne). Il parlait des expériences chez des étudiants de psychologie utilisant l'ordinateur pour leur étude de statistique, et aussi des modèles utilisés dans l'intelligence artificielle pour la formation professionelle future .
- Le jeudi matin nous étions surpris par une démonstration à l'ordinateur par trois jeunes chercheurs de l'Université Libre Francophone à Bruxelles. En un langage spontané, et en même temps rapide, ils démontraient leur système pour les élèves de l'enseignement secondaire en utilisant l'ordinateur pour la recherche de références (par 3 exemples, à partir de définitions et de relations logiques).
- Les Bruxellois étaient suivis de deux Canadiens, Monsieur Bernier et Monsieur Crespo, de l'université de Montréal (Québec). Leur projet, appelé Caméléon, est un système à l'aide de l'ordinateur pour l'évaluation des apprentissages chez les élèves et se propose d'englober les objectifs dans un programme.
- Le dernier locuteur de jeudi était Monsieur Pedro de l'Université Ouverte d'Espagne (Madrid). Il présentait le projet "Athène", ou l'introduction de l'ordinateur dans l'enseignement secondaire espagnol. Les propositions sont semblables à celles de la Belgique; par exemple, les écoles expérimentales, la formation des professeurs, etc. Mais dans l'aperçu de la planification on constate une série d'écoles plus dispersées, tout comme dans le recyclage des enseignants.
- Vendredi matin les membres de la commission ont reçu un rapport de Monsieur Louwyck, de l'Université d'Anvers (la Flandre), constituant une comparaison entre les Pays-Bas et la Belgique. Il traçait par exemple le parallélisme des objectifs et du système de soutien. Malheureusement en Belgique nous ne disposons pas d'un budget sérieux pour cette innovation fondamentale.

- Et finalement notre coordinateur, professeur Laeng avait expliqué la situation en Italie, où il existe un développement considérable de moyens audiovisuels et de moyens informatiques dans la société et dans la culture; mais où la diffusion dans les écoles est beaucoup plus limitée. Il a également fait la distinction entre deux phénomènes: les audiovisuels favorisent surtout une communication à sens unique, par contre l'informatique sollicite l'inter-action de demandes et de réponses dans les deux sens.

En conclusion, le groupe a enregistré plusieurs nouveautés intéressantes au niveau expérimental; la véritable révolution des nouvelles technologies n'est pas encore réalisée, mais il y a néanmoins des démarches envers l'innovation, répondant aux changements de la société dans divers contextes.

RAPPORT OF WORKING GROUP 3.: TECHNOLOGY'S IMPACT ON RELATIONSHIPS BETWEEN GENERAL EDUCATION AND EDUCATION FOR CAREERS.

Group co-ordinator: J.L. Garcia Garrido

Rapporteur: Fransec Pedro di Garcia

Three main points were discussed in this Commission. The first one was related to the theoretical principles governing relationships between general education and education for careers. Professor Reijo Raivola's views were especially fruthful in identifying some parallelisms between the effectif industrialisation on the spread of compulsory education, on the one hand, and the new impact of new technologies on today's educational systems on the other. Also very interesting were the views of Professor Giorgio Vuoso concerning the philosophical principles of technological education. According to him it is absolutely necessary to demystify science's claim to absolute knowledge, restructuring the philosophical principles in order to avoid the encroachment of the technological approach into the sphere of ethical valus.
The second point was the analysis of several case-studies. The first one, the Netherlands, was introduces by Professor Kremers. His paper dealt with the Dutch educational system and the position of technology therein, and some underlying dilemmas which have to be faced now in the Netherlands. The impact of modern technology on Hungarian education and especially on young people's attitudes was examined by Professor Illes, pointing out the need for a new balance between general and vocational education in Hungarian curricula. Two papers were devoted to the care of Italy. Professor Lunetta adressed his paper mainly to the different characterisations of school aims in Northern and Southern Italy, both parts of the country reflecting different assumptions about the introduction of new technologies in edcuation according to their quite different contexts. Professor Telmon's paper took account of reform perspectives in Italian secondary education. In this case the relationships between school and the labour market, on one hand, and between general and technical subject matters, on the other, seem to be particularly important. The last case-study was devoted to the Greek comprhensive, multilateral high school by Professor Cassotakis. In his opinion, this new comprehensive school could sovle of those

problems arising from technological evolution and facing both education and the labour market. Existing circumstances in the socio-political context insure the succes of these reforms in this country.

The last point was that of comparative surveys. Professor Gomez Ocana and Professor Pérez Alonso-Geta, presented three papers, especially interesting from the point of view of the use of statistics in comparative education. Accordingly, three problems were introduces: technical subjects in secondary education curricula; assessment of technical knowledge for university admission; and curricular objectives in American high-schools and univerity admission exams. Another paper, by Professor Rius Lozano, also used the same methodology in comparing the impact of technology in vocational training curricula between the Soviet Union and Spain. Professor Hörner's views are very helpful in providing some comparative data concerning European experiences. His paper dealt with attempts to introduce technical education in schools in France, England, FRG, DGR, and the Soviet Union, and showed that the same phenomenon appears: although eacht country attempts to introduce 'Technik' in school curricula, there is a tendency for technical subjects to be marginalised or adapted in a way quite different from the original proposals and it seems to be due to a dicotomy between scientifical and technical thinking. In this connection, Professor Iram showed that, in comparing the Israeli and Swiss models of vocational training, they both developed organically.

Several discussions arose from these contributions. Many of them focused on the concept of technical culture which was defined, in Professor Raivola's words, as a model of society where 'all human needs are institutionalised, and all institutions are technologised, stressing the negative aspect of this definition which was deeply analyzed. Besides this, the introduction of such a model in school systems was examined, pointing out the main problems and issues, at a national level as well as in a comparative examination, which tended to show that work/technological purposes coulc be seen as extremely difficult to introduce into the whole school system because of structural and contextual elements within and around it. Schools seem not to be, in the light of there analyses, the right place for a technical/vocational education to the extent that, up to present, they have proved to be unsuccesful in achieving those objectives. Despite the cultural diversity of the presentations there was remarkable identify of views on the problems and proposed solutions. Solutions that seem to be in the modification of structures rather than in curricular approaches.

REPORT WORKING GROUP 4.: TECHNOLOGICAL DEMANDS UPON RECURRENT EDUCATION, ADULT EDUCATION, NON-FORMAL EDUCATION.

Group co-ordinator: E. King

Rapporteur: Guy Neave

Monsieur le Président, Mesdames, Messieurs,

Ceci n'est pas comme, ça n'a pas la prétention d'être, un proces verbal tout à fait, comment dirais-je complet, encore moins une présentation objective des séances qui se sont déroulées sous la direction du professeur Edmond King. C'est plutôt, si vous voulez, une espèce de perception phénoménologique, vue dans l'optique évidemment des préjugés de votre reporteur. La séance est déroulé par une introduction du professeur King qui nous a évidemment fait état de la situation actuelle dans laquelle se trouve et se déroule la problématique de la nouvelle information de technologie. Il nous a porté à notre connaissance que l'accélération dans le domaine du savoir scientifique va toujours croissant. Car voici que d'une dizaine d'années le savoir humain s'est doublé en l'espace de cinq ou sept ans. Et aujourd'hui il est possible que le volume de l'étendu volumétrique du savoir humain peut s'agrandir par une fois au moins tous les ans. Donc cette accumulation du savoir pose non seulement des applications des plus importantes dans les relations humaines, mais aussi comme nous avons souvent entendu lors de cette séance, dans le domaine de ce qu'on peut appeler le déplacement de la structure de l'emploi. Il nous a également, il nous a rappelé, fait savoir que d'ici peu, le secteur tertiaire va être, va jouer un rôle primordial dans le tout de nos économies européennes. Ceci dit, nous avons eu des présentations dont la première était faite par Madame le professeur Valls, qui a traité l'expérience de l'application des technologies nouvelles dans le contexte de la formation des jeunes au milieu rural. C'était pour elle et aussi pour les membres participants de ce groupe un moyen non seulement de faire participer les jeunes, de mobiliser cette société parfois regardé comme pas de nos jours, des technologies qui se sont pour la plupart basées dans les villes, mais aussi de permettre aux individus, des jeunes gens au niveau individuele, la possibilité de s'exprimer et donc par intermédiaire des techniques audio-visuelles, de se réaliser un moyen de participer dans la société en pleine mutation. On a dit que, évidemment à partir de ces instruments, il était possible de combler l'écart que, traditionellement historique, a toujours persisté entre la ville et la campagne. Et que, en même temps, en agissant à partir des jeunes et surtout de 14 à 18 ans, ils sont, dans le context rural un instrument de mobilisation social, les plus importants. Il était également moyen de donner, à porté de créer si vous voulez, des moyens de participation plus positif qui s'étendent dans le contexte parental. Donc par l'intermédiaire de ses instruments, il est possible de procéder un renouveau et la participation dans ces pays là. Ce sont, si vous voulez, un aspect de ce qu'on peut appeler la dimension spatiale de l'impact des nouvelles technologies. Une autre dimension qui a été touchée, que nous avons, qui nous a été promise et présentée par le professeur Marin d'Espagne, était une analyse profonde et à la fois brillante du problème des systèmes des universités ouvertes. De ce discours, qui était d'ailleurs très suivi et ainsi nourri on a retenu plusieurs conclusions qui ne sont pas des moindres. D'abord que, faisant comparaison entre des systèmes d'adaptation récents dans le contexte des Open Universities et ce qu'on dise des universités didactiques classiques, il y a une certaine convergence de la culture des étudiants, culture qui se relève par le fait, par example, que bien des étudiants dans les universités classiques font maintenant état d'avoir un emploi à mi-temps et que, évidemment dans le contexte de l'Open University, c'est un, si vous voulez, une caractéristique significante de ce organisme que la plupart, sinon la totalité de leurs étudiants, sont des étudiants qui travaillent. Donc nous avons par cette innovation une convergence entre les systèmes historique et classique, et le système maintenant, que nous estimons faisant partie de notre monde nouveau. Le plus important de cette matière qui ne m'a pas beaucoup surprise, mais qui est quand-même réconfortant c'est que compte tenu une fois que vous avez fait défercation de ceux qui ont quitté de manière prématurée les universités, les résultats obtenus, les performances des étudiants qui se présentent aux examens, que ce soit dans le système open ou dans le système classique sont approximativement les mêmes. Bon. On a également parlé de l'influence motivatrice que puisse avoir sur les étudiants la notion de travailler prèalablement ou de faire partir du monde de travail, ou si vous voulez la culture non pas de l'appétit mais les priorités politiques dont le monde fait parfois place au besoin de la réalité du monde de travail, un facteur motivant non pas négligeable. Ensuite nous avons procédé, nous avons eu le bonheur d'une présentation de la part de Norbert Lacoste sur la situation telle qu'elle existe au Canada et particulièrement en Québec. Pour bien de nous cette présentation nous a permis de saisir des éléments dans le pays qui nous est bien connu, mais qui en quelque sorte fait affirmer des tendances qui existent déjà ici chez nous. Par exemple, la création des groupes-cibles à l'interieur du système d'enseignement plus précis plus diversifiés, plus précis à la fin, et au cours, en même temps, faisant partie de ce phénomène tout aussi prononcé, cette espèce d'effritement, espèce de menace qui se pose devant l'unité familiale et tout, donc de menace à la fois, de, non pas d'aliénation, mais de désolation sociale. Ca met en rapport la relation dialectique des nouvelles informations technologiques qui à la fois sont instrumentation ou moyen d'accélérer cet effritement social et selon le Prof. Lacoste doivent être aussi un véhicule pour combler cet effritement social. Egalement avons nous pour équilibrer cette présentation de la part de la partie Est du Canada, une présentation faite par le Prof. Katz sur ce qui est la situation en Colombie Britiannique.

Il est tout évident pour bien des participants de notre groupe, l'aspect le plus important de la technologie c'est que ça représente une extension de la volonté humaine; on ne devrait pas on dirait voire la technologie, que ce soit la nouvelle technologie en dehors de ce contexte à la fois des valeurs humains, du contexte politique, du contexte économique. Bien sûr, évidemment, pour bien des gens et nous ne sommes pas les seuls il semble avoir un écart qui se creuse entre les systèmes éducatifs, je dis pas de l'école et la société, évidemment, écart qui semble être élargi par l'influence des nouvelles technologies de l'information. Il semble également, et je vous rappelle que c'était partie de mon discours préliminaire, que ce écart se creuse davantage entre les riches et les pauvres de notre société, et également des riches et des pauvres sur le plan international.

Néanmoins, ceci dit, le Prof. King nous a fait rappeler que même dans les pays soi-disant moins développés, il peut avoir des technologies très avancées. Par exemple, on a parlé du téléphone à énergie solaire qui a été installé aux Indes dans tous les villages, ce qui représente une espèce de sursaut si vous voulez, dans l'application de la base des technologies avancées dans les pays de moindre développement. Mais pour nous, pour ce que vous pouvez appeler, le plus important c'était quand même que si le développement des nouvelles technologies de l'information doit se continuer, davantage il est important et surtout ne jamais oublier que les bienfaits et les capacités technologiques que représentent cette instrumentalité, doivent être partageé avec le Tiers Monde. Nous ne pouvons pas croupir dans cette optique uniquement ethnocentrique, si vous voulez la notion du monde industriel, le monde où l'impact premier des nouvelles technologies est déclaré.

Pendant l'après-midi de hier, nous avons eu une intervention de la part du Docteur Straka sur l'impact qu'avaient les nouvelles technologies de l'information sur le troisième âge. Une étude, à mon avis qui était particulièrement intéressante du fait que c'était basée sur une enquête empirique et donc un moyen non seulement extrapolé des études qui sont basées sur des idées d'intellectuels mais à partir des expériences du vécu. Ceci s'est déroulé également en Californie du Sud à San Diègo. Le plus important de cette étude c'est de montrer comment on pourrait, si vous voulez renverser la direction de la communication c.-à-d. jusqu'à présent nous avons eu la communication à partir des chaînes de télévision vers le grand public. Maintenant comment former le grand public et donc, en particulier les gens du troisième âge pour, si vous voulez, s'en servir de cet instrument pour entrer en communication avec leurs semblables? Comment, si vous voulez, se servir de cette instrumentalité pour être au service des consommateurs, au service des groupes dont l'accès est moins développé? Comment donc s'en servir de cet instrument aux besoins humaine, aux besoins des groupes précis? Evidemment nous avons conclu qu'il y a un problème qui se passe d'abord dans l'aspect du troisième âge; les gens qui sont plus à participer pour le renversement de cette procédure automatisée, agrandissement, l'instrumentalité, sont pour la plupart des gens qui ont un capital culturel et informatique qui est quand-même non négligeable. Principalement les gens qui ont eu des occupations qui ont exigé d'eux une information supérieure. Donc nous avons un problème du coût d'investissement que pose l'accès au NTI qui, par moyen de cette enquête menée par le Docteur S et son collègue à l'Université à San Diègo, retrouve d'autres dimensions que nous avons déjà discutées en séance en plein air.

L'avant dernier papier était présenté par notre collègue Americain, le docteur Laurence qui traitait de l'utilisation des moyens d'information technologique dans une problematique qui est d'ailleurs pérenne et durable et cruciale à la fois, c.-à-d. le problème de la paix et de la guerre. Comment, si vous voulez, rendre plus conscients les gens dans un pays particulier qui était fortement dépendant de l'industrie militaire aux Etats Unis, des dangers que representent par exemple, franchement la menace nucléaire? Ceci par moyen, par intermédiaire des systèmes audiovisuels, la cassette et tout cela. Comment organiser l'opinion publique, comment implifier des questions qui sont plus importantes en se servant de cette instrumentalité nouvelle? C'était aussi une étude des plus importantes, étant donné sa notion pour moi pragmatique.

En dernier lieu nous avons le bonheur d'avoir une présentation de la part du Prof. Valls sur l'effet qu'avait les systèmes d'enseignement à distance dans deux pays, à savoir la France et la Suède. Pour elles la dimension cruciale était la notion de legitimité académique, comment il est possible pour les systèmes qui n'ont pas eu, si vous voulez, réputation qui date depuis des siècles, de se trouver sur pied d'égalité et cela rapidemment. Car c'est par l'intermédiaire de ces organismes, de ces instrumentalités qu'on peut mettre évidemment les besoins et les savoirs de la population en général à jour. Elle a parlé à partir des études de cas en France, et par les réformes mises en oeuvre à partir des années soixante en Suède. Ceci dir, nous savons que, comme pour rejoindre les conclusions qu'ont été déjà présentées par le Professeur Marin, une fois que les drop-outs ont quitté prématurément ces systèmes-là, il semble que les performances des étudiants sont donc presque similaires à leurs homoloques plus fortunés qui étudient à plein temps.

Quelles sont les conlusions générales de toutes ces, si vous voulez, conclusions spécifiques? Il y en a plusieurs dont j'aimerais vous faire état. D'abord, et c'est une remarque qui était largement présentée par le Professeur Katz et qui était partagée par tout le monde: les nouvelles technologies de l'information aussi utiles qu'elles puissent être, ne devraient jamais agrandir l'écart sur le rapport humain entre l'étudiant, le professeur, entre les étudiants et le corps enseignant. On ne devrait donc pas chercher dans cette instrumentalité un refuge pour des problèmes qui sont franchement d'ordre humain, non pas d'ordre technique.

Deuxième proposition était faite lors de la discussion de ce matin, un point que j'aimerais ici souligner, c'est ce qu'avaient accentutée toutes les discussions dans ces groupes, il y a une chose dont il faut toujours se rappeler, c'est assez simple: dans le contexte des nouvelles informations de technologie, il est important surtout de ne jamais croire que la technologie se présente tout simplement comme un "truc", comme on dit dans le jargon américain, "technological fix". La technologie fait partie d'un contexte humain et peut avoir évidemment des raisons dans les deux sens. La technologie est une instrumentalité dialectique.

REPORT OF WORKING GROUP 5.: "TECHNOLOGICAL DEVELOPMENT AND ITS IMPACT ON EDUCATION IN THE THIRD WORLD"

Group coordinator: M. Debeauvais

Rapporteur: C. Bikas Sanyal

The working group on Technological Development and Its Impact on Education in the Third World was organised by Professor Michel Debeauvais, the Group Co-ordinator. 40 participants of the Congress enlisted for this group - 25 from developing countries and 15 from industrialised countries. Prof. Seth Spaulding, Director, International Bureau of Education of Unesco in Geneva, was nominated as the Chairman of the working group and Dr. Bikas C. Sanyal of the International Institute for Educational Planning of Unesco in Paris was nominated as the Rapporteur. There were 20 written contributions. The presentations made in the group and the discussion that followed led us to identify several themes, all having special reference to the Thrid World. These are:

1. Technology and its place in the world of knowledge and the society at large.
2. Technological development, economic growth and north-south relations with special reference to education.
3. Technological development and its impact on the labour market and corresponding educational needs in the Third World.
4. Application of new technology in the education system in the Thrid World, and finally
5. Implications for educational policy in the Third World.

The report that follows considers each of the above issues as discussed in the group.

1. Technology, the world of knowledge and the society at large.

Science represents mankind's search for knowledge in order to gain some understanding of the mysteries of the universe. This search was carried out in the past through a combination of mathematics and astronomy. For natural philosophy, as science was called in the past, the minor principles discovered in the process of the search for knowledge were only of secondary importance. However, the accumulation of knowledge did not restrict its contribution only to mental and spiritual satisfaction. The contribution of these discoveries in improving upon the material conditions of human life was soon appreciated. Technology, therefore, replaced the haphazard, trial and error improvements in techniques, by a systematic method based on the expectation for complete taming and control of natural forces. It was destined to guide and control the development of techniques to improve upon the conditions of human life. Today, subtle transformations have occured in the perception of science. Science, now, hardly becomes visible in any other way than through technical manifestations. In this form, it has given the human race the capability to change and manipulate nature. Knowledge for its own sake is losing its value. Science is losing its justification of its own and is merging with technological research and development. This development, according to some, has led to a relationship between technology and environment based on the maximal exploitation of natural resources and between technology and knowledge ruled by the criterion of efficiency. The evolution of technological development has also changed the relation between society and knowledge to a type where instrumentalism plays a dominant role. According to the same argument the role of human beings in the production process has been subsidiary to the technology used. According to others, technological progress is liberating human beings from the drudgery of work, providing improved health conditions, better nutrition, and better communication among people.

Countries suffering from lack of communication facilities in the past are benefitting from technical progress in the use of radio, television and satellites. However, such progress has so far been the monopoly of the industrialized countries.

Concerns have been expressed by some about the shortcomings of the high technological model for Third World countries which have been importing, in most cases, such technologies, sometimes according to their own decision, often according to the intention of the exporting countries. Frustrated about the ill-effects of exaggerated application of technology, one participant asserted that the complec relationship involving the human race, society, environment, technology and knowledge, should have the human being as the centre of development who will be able to control the technology used.

Educational policies should not be associated with policies violating the criteria of survival, social order and balance of physical environment.

It has also been asserted that education has a role to play in incalculating the skills of exploring, exploiting, managing and conserving natural resources on the one hand and of negotiating technology transfer, adapting, designing and developing new technology on the other, to enable the clientele to help technological development. Education has the more important role in providing proper attitudes and values so that the recipients impose on the society conditions for meeting the criteria mentioned above.

2. Technological development, economic growth and north-south relations with special reference to education.

Technological development has no doubt contributed to economic growth. This development has led to new forms of international division of labour and internationalization of means of production, knowledge and expertise where industrialized countries have a more dominant role. What kind of products could be exported, what type of technology could be transferred, what part of the production process to be handed over to the recipient country are decided by the exporting country. The knowledge gap between the industrialized countries and the Third World countries is widening, the power gap to control the economies is also widening in favour of the industrialized countries as well as the gap in economic well-being is increasing. The new international division of labour is generating some amount of industrialization in the Thrid World countries. However, because of the stronger emphasis on efficiency than on equity, disparity among the social groups within a country is also widening. The Third World countries, being in a subsidiary position and having complex socio-political constraints have been unable to improve upon the quality of life of the masses. Poverty, disease, malnutrition and illiteracy still prevail. On the other hand, imported technology changes the life style of the privileged few, increases the expectation among others and develops the risk of social disruption. Often the multinationals have been over enthusiastic in exporting technology to the Third World countries at their own interest without looking into the interest of the countries, sometimes at a very high price contributing to increased financial dependence of the recipient countries. They had to borrow money to buy the technology, often failed to repay the debt because of inefficient production system on the one hand and lack of marketability of the products in the hard currency markets because of trade barriers on the other. This resulted in critical debt burden. It has been argued that those countries which have been late comers in the industrialization process, have been able to take advantage of the lessons learnt by the initiators. However, often such lessons have not been available to the recipient countries resulting in the repetition of the mistakes. Overzealous exporters and importers have often ignored the lessons as well, contributing to the increase of dependence of the Third World countries on the industrialized ones. The increased transfer of technology had its implications not only for the Third World societies as such but also for the labour market and the education system as discussed below.

3. Implications of the technological development for the employment market of the Third World countries.

In many Third World countries technological development depends entirely upon imports of technology from the industrialized countries and industrial development is confined to intermediate and consumer goods. It has been observed that the qualifications and skills required for the production of these goods are becoming increasingly specialized and contributing to the polarization of the labour force. The requirement of high level manpower is decided by the muntinationals according to their investment, production decision and choice of technology, specially in the countries where 'twin-key' type of technology transfer takes place. In those countries where investment decisions are at least partly controlled by the national authorities, the conditions of import of technology oblige the host country to orient its choice and application of technology to the development of techniques and knowledge occurring outside. This reduces the autonomy in investment decisions and in formulating employment policies. The organization of work, recruitment and promotion policies get distorted. The segmentation of the labour market increases, with a tiny privileged sector and a large national sector. On the other hand, technological development, if properly assimilated and adopted in the country with local control, can generate new employment, improve the working conditions of the citizens and their life style. This requires sufficient preparation on the side of the Third World countries. If changes in technology take place without a proper choice of the economic sector and the product, if such changes occur for saving of labour, the size of employment will reduce the problem of unemployment. If it is applied to new products and to new economic activities, technological progress will help generate new employment. In Third World countries, where much of the naturel resources is still untapped, and a large part of teh economy unorganised, technological progress may increase the size of employment, thus reducing the problem of unemployment, unlike the situation in the industrialised countries where the entire economy is organised and new products only replace the old ones while machines replace men. Technological development not only influences the structure and the functioning of the labour market, it also influences the education and training system of the Third World countries. In this area the role of the multinationals is important. The special kind of organization of work, production process and the technological call for workers with a special kind of skills. Imparting such skills has been the main responsibility of the multinaltionals and foreign institutions and agencies. Very often this new type of training has been different in content and structure from the type of education and training prevailing within the country and has not given due consideration to the educational philosophy and the culture of the country. It has covered a small segment of the society - selected from the urban elites and neglected the large sector of the population outside of its domain. Segmentation which started in the labour market, now has pervaded the education system as well. The dependence on imported technology has resulted in dependence in the field of education and training. It has also generated, according to some, a new kind of 'transnational intelligence industry' through foreign studies. The developed countries receive the students and train them the way they want, with values and attitudes favourable for the developed countries. These students once back in their countries become 'bridge-heads clients and relay stations' for the interests of the dominant countries. The number of foreign students has increased nine times during 1950-80 around the world. In 1981 73 per cent of all foreign students were from developing countries studying in the developed countries, the largest proportion belongs to Asia (43.5%), followed by Africa (19%) and Latin America (10.5%). Given the size of the higher education student population in Africa, the proportion of students abroad in relation to the continents is extremely high. However the lack of higher education facilities within the continent, the need for modern, scientific and technological know-how and the availability of this know-how in the developçed countries oblige the Third World countries to send their students abroad. Some educators of the European universities have delineated several aspects of the co-operation between universiteis of the Third World and European universities. According to them, the European universities hsould cater for the needs of the soiety and mankind by dealing with such vital issues as peace, ecology and technology for their own survival and legitimization. As to the co-operation with Third World countries the following criteria are suggested: common interests, possibility to co-operate on equel terms, scope for improvement of horizontal communication, possibility of establishment of a balanced network of communication from dependency to interdependency and possibility to profit from intercultural differences. This takes us to the next issue of the discussions.

4. Application of new technology in the education system of the Third World

Technological development in industrialized countries has pervaded their educational delivery system. This, in its turn has also influenced the educational delivery system of the Third World. The introduction of radio and television for education in the Third World countries had mixed results. The educational television in the Ivory Coast was not a successful experiment. The radio clubs set up with foreign assistance in Niger and Senegal for French language instruction was a success. Unfortunately, similar application could not be made for national language instruction due to lack of finance. The Third World countries faced a dilemma as to wheter to adopt a foreign language for official purposes or help to develop the national language to retain cultural identity. It was suggested that the national language be adopted for all, specially at the lower levels of education and retain the foreign language for international co-operation while developing and modernizing the national language at the same time. It was also observed that before the introduction of new technologies in education teachers should be well trained. In most cases, teachers were ill-equipped and the equipments were not well maintained because of the lack of skilled manpower and spare parts. Concerns have been expressed that due to international competition the export of new technologies has been pushed too hard and too fast by the foreign companies to the Third World countries without giving them sufficient time to build up the infrastructure to use them effectively. It has been suggested that before adopting a new technology, a critical evaluation of the technology should take place through pilot experiments while maintaining the traditional techniques of teaching/learning and improving upon their quality. It has also been noted that the content of education in the Third World countries should be geared to the new technological revolution, if these countries have to benefit from this. Emphasis should be laid on the development of skills to explore, exploit, manage and conserve the natural resources the countries possess. Emphasis should be laid also on the acquisition of such skills as negotiating terms of trade in technology, depackaging, adopting, designing and mastering the technology that is being imported. It has also been observed that large, urban universities in some Third World countries look for new techniques more than small, regional universities.

5. Implications for educational policy.

Finalyy, it was noted that the import of technological development in the education system of the Third World has given mixed results.

Given sufficient attention to (i) develop the local infrastructure (ii) negotiate local control on technology and (iii) establish proper criteria for formulating policies for education and for international co-operation, technological development could have a good impact on the education system of the Third World. The educational policies of the Third World should not, however, reject the traditional methods of instruction and should try to improve upon their quality while critically reviewing the new technology before adopting them to replace traditional methods.

REPORT OF WORKING GROUP 6.: THE IMPACT OF TECHNOLOGICAL DEVELOPMENTS ON TEACHER EDUCATION AND TRAINING, INITIAL AND IN-SERVICE.

Group coordinators: W. Decoo & G. De Corte

Rapporteur: W. Decoo

Commission 6 had as its duty to study the impact of new technologies on teacher training.

I will give this report in two parts, first a quick summary of the papers, then a summary of practical points and suggestions in relation to teacher training.

Three papers were presented that approached the problem from widely different angles.

The paper by Mr. and Mrs. Elias, from the University of Lisbon in Portugal, identified technology, not as a discipline in itself, but as an extension of science in all branches, thus making it mandatory for all teachers to get acquainted with it. They have stressed especially the importance of using new technologies in recognizing and analyzing reachable, observable phenomena from our daily experience, tying them with social and moral values. They have reported on a experiment in teacher training showing that integration of the learning experience in real life situations leads to better results.

The paper by Mr. Prince, of the universities of Reims and Paris V in France, was meant as a more thorough critique of pedagogy in its relation to new technologies. He feels that technologies promise a degree of efficiency and productivity that cannot always be proven scientifically. His discussion was therefore more geared towards the epistemological implications of our theme, pleading for a more critical and careful approach of new technologies in education.

Mr. Döbrich, of the German Institute for International Educational Research, discussed the rise of new technologies at the very moment when political and academic decisions are being taken to limit the appointment of new teachers in Germany, where about 170 000 qualified teachers will be unemployed by 1990. Mr.

Döbrich notes, however, that this policy is part of a swing of the pendulum, and that the drastic reduction of new teachers will only lead to a new drastic shortage of teachers, precisely at a time when teachers are so badly needed to introduce the new technologies.

The three papers thus included valuable and interesting perspectives for the discussion. I should note that ten speakers were scheduled for this Commission on teacher training, but that seven of them did not show up. This, however, can probably be explained: M. Döbrich, in his paper, had indicated that teacher trainers positions are not very secure at our universities and that they tend to be taken away by other faculties. The seven speakers, all teacher trainers, who did not show up were probably the living proof of that situation. Happily there were three left.

Now as to the practical items and suggestions in connection with new technologies and teacher training.

Representatives from Belgium, Egypt, France, Germany, Portugal, the United Kingdom; the United States, reported on the situation in their respective countries. The same central items were common to them all, namely:

- a course on new technologies is or should be part of the teacher training curriculum. This course, however, should not be geared towards very limited applications or specialized technological know-how: rather, such a course should encompass
  - an introduction to the vast variety of new technologies, including didactic instruments, audio-visual equipment and computers.
  - the application of problem-solving techniques
  - the application of didactic criteria for efficiency
  - an introduction to the resources, so that teachers know where to turn to for information and evaluation.

  It was the opinion of the commission that such a course should be offered by someone who has a large and up-to-date view on new technologies, not by a mathematician or technologist who would not be able to broaden the horizon and view the technologies from an educational angle.

  In this connection, the commission felt that all those responsible for teacher training should be involved with new technologies, rather than leaving this to one expert.

However, an expert should be present to advice on ongoing developments and on problems of compatibility and suitability.

- Educationalists should worry about the pedagogical training of the many people involved with teaching about new technologies, especially in the industry, where specialists are constantly involved in training people to work with new technologies. Some didactic input in such training would be most welcome.

- New technologies can be used effectively in the training of teachers, among others in video-observations, in computerized interaction-analysis, and others.

- New technologies should solve problems, not introduce new ones into education.

- Teachers and educators are not video-makers, filmers or programmers: these things belong to other professions in their own right. But teachers and educators need to learn to communicate with those professionals, to express their wishes, to formulate suggestions and demands.

- The commission also expressed a deep concern for new technologies that would only profit the educational system in the the rich and industrialized nations, and not in the Developing Countries. Therefore it seems advisable that producers of new educational technologies pay special attention to the optimalisation of simple and affordable tools, rather than to spectacular but expensive products. Special attention should also be geared towards the use of new technologies that would enhance the improve conditions in the Third World. These need to be introduced in teacher training programs in such countries, so as to disseminate vital knowledge to the people concerned.

- The commission finally expressed the obvious statement that the quality of education does not depend on new technologies, but on deeper, human factors. The quality of the teacher as such and of the educational system is of foremost importance to success.

To close, may I just mention that Commission 6 was a highly interactive group, with lots of questions, comments and ideas that certainly contributed to excellent working-conditions. In that sense, the theme of the new technologies has provided for old human atmosphere.

GENERAL REPORT: SCIENCE, TECHNOLOGY AND EDUCATION

Rapporteur general: Brian Holmes

It would be presumptious of me to attemt to summarise in one brief paper, the plenary speeches, commission reports, an account of the proceedings of the Dutch Speaking Society's panel meeting ang the pre-conference publications based on the clear analysis provided by the host society and the CESE committee. All of these features facilitated informal discussion at one of the best prepared conferences I have attended.

Consequently I shall reflect selectively on what I have read and heard this week in the light of the analysis provided and in terms of my own approach to comparative education research.

Since Guy Neave referred to cycles of societal change in his paper and since L Cerych listed some of the lessons to be learned from comparative research in the field I make no apology for referring to the 1954 Year Book of Education - which was my introduction to substantive Comparative Education research - prepared under the inspiration of Robert King Hall of Teachers College, Columbia in collaboration with the University of London Institute of Education. This Year Book - a pioneer in the field - dealt in comparative perspective with relationships between technological development and education.

From it we learned several lessons some which have been stressed from time to time during the week. Some new lessons were mentioned by Cerych. The most important of all these lessons is that relationships of the kind we set out to examine are extremely complex. I conclude, therefore, that if we are to make progress there is need for a clearly articulated method of research. Theory of Social Change.

In view of the complexity of the relationships between aspects of society and to analyse the problems created by technological innovation, a theory of social change is needed which provides a way of classifying features of most if not all, societies. Most of the nineteenth and twentieth century theorists - and the point was made by Cerych - stressed that in the face of technological changes some, or a majority of, people have difficulty in adjusting mentally - in terms of attitudes, knowledge and behaviour - to institutional changes. A theory is needed, as

Neave mentioned, to identify both change and continuity in societies. There are several classical theories from which to choose. Marx, Ogburn and Mannheim among others classified societies in ways which make it possible to identify scientific, technological and institutional changes and which point to the slowness with which a majority of people adjust to such innovations.

Theories, however, should not be taken as representing the real world or to stereotype individuals. As Margaret Sutherland pointed out, it would be unwise to assert that all teachers are attitudinally incapable of responding to the introduction of computers into school classrooms. It is also less than useful to generalise about new technologies as though their impact is bound to be the same under all circumstances. Or that all innovations are likely to be equally well received or equally strongly resisted in all societies. Each technological innovation should be treated as unique and its consequences examined in detail and in a number of different nation states - if in Comparative Education we are going to continue to make national systems the basis of comparisons.

To illustrate this point Plomp, for example, reeled off a host of new technological artefacts based to be sure on the invention of semi conductors.

> "... computers, cable systems (satellite communication digital telephone networks, broadcast technologies), storage technology (silicon chips, floppy disks and hard disks) video technology and video disks and information services (e.g. videote systems, information networks electronic conferencing) as though each of them were similar in terms of their acceptability wide use and impact.

Though far more demanding in terms of research, it is highly desirable to select for analysis a specific innovation - historical examples migth be the wheel, the plough, the printing press, the steam engine and the internal combustion engine - and work out how and against what resistance it was introduced and what were its societal effects - politically, economically and educationally. Perhaps a simple example will illustrate the point. In many countries the sale of home micro computers with software games is phenomenal. Millions of children - of all ages - play these games to fill their leisure. From which social class or nation the majority come depends on the cost of the computer, the availability of supplies and so on. It seems unlikely, however, that the use of home computers to play games is restricted by serious doubts about whether they are desirable, although it would be unwise to assume that they are universally approved of. On the other hand, attitudes to the use of similar computers for educational purposes may vary quite considerably. Their use in US schools preceded by several years the introduction of them into virtually every primary school in England and Wales. The willingness of teachers to use them, the desire of pupils to learn from them clearly varies greatly. Moreover the ability of teachers to use them effectively and the ability of pupils to learn as a result of CAL is probably even more variable. They are not a universally accepted panacea.

A comparative dimension reveals the dangers of generalising about the introduction and efficacy of similar hardware and software into different nations. The technological innovation and the problems it creates may be common - and consequently the starting point of a comparative analysis - but the outcomes are likely to be very different and will depend upon particular national circumstances. Among these circumstances according to Dore are national pride and consciousness for which schools have some responsibility and which mobilises responses to development. He writes:

> "A nation's schools have a lot to do, in the first place, with the level of national consciousness and cohesion which is an important factor determining the ability of the State to mobilise the resources necessary for the drive to catch up."

On the other hand as Wolfgang Mitter pointed out in his introductory remarks that the undesired effects of a desired innovation are not always recognised before the event and to anticipate these unwanted consequences comparative educationists have a role to play.

Problem identification

Having stated that a theory of social change is needed to identify the problems arising from technological innovation and having warned against generalising about innovations and the reaction of individuals to them, I now propose to make some methological generalisations which may not be accepted, but will not be subjected either to empirical verification or empirical refutation. They are intended to provide a framework within which coherence can be given to the many comments made and arguments advanced during the course of the week.

1. It seems reasonable to assume that through the work of scientists and engineers, relationships exist between scientific generalisations and technological innovations - namely through inventions. Any unilateral causal relationship between the two is problematical. After all it is likely that a simple crowbar was used

before the principles of the lever were articulated. It may further be assumed that is is through social institutions that inventions have an impact on individuals in society at large. For example the steam engine is based on scientific principles relating to heat transfer and the relationships between the force and the pressure and volume of a gas or vapour. Technologists invented steam power driven machinery and other individuals created factory and railways systems which directly influenced the lives of a very large number of individuals.

2. Some inventions and their further development have a direct impact through institutions on the life of individuals. Other inventions do not. For example through the banking system technological innovations have made it possible for individuals to cash cheques far more quickly than before. Similarly the speed with which travel agents and airline staff can check on the availability of seats on a particular flight has been greatly increased as a result of the introduction of computers. The impact of other innovations on individuals is less direct; for example unless it is dropped, the influence of the H bomb is indirect and mediated through political systems. Since Hiroshima direct contact with the preparation, testing and the results of dropping an H bomb has been limited to a small number of scientists and technologists, and a tiny number of unfortunate Japanese fishermen.

3. Time intervals between the statement of a scientific principle and its realisation in an invention and in an institution vary. Newton's Laws made it possible eventually for men more than two hundred years later to reach the moon - a universally acknowledged achievement. The internal combustion engine was based on Carnot's cycle. Decades later travel in automobiles and jet aircraft is now accepted virtually everywhere by everyone. Yet many urban dwellers now campaign against the unanticipated and unwanted effects of exhaust fumes on the atmosphere.

4. Since these relationships should not be regarded as deterministic there is no necessary sequences of events. In solving one problem - how to get from A to B more quickly - human beings create other problems - for example atmospheric pollution. Assumed relationships should therefore be seen as providing a framework within which problems and solutions to them can be analysed.

5. Into these equations, relationships between aspects of an educational system and scientific discoveries and technological inventions can be assumed. They allow us to examine the

> problems technological innovation creates for educationists and the extent to which educational solutions to societal problems can succeed.

On the role of education in the promotion of technological innovation and implicity societal development there was no consensus. For example W. Hörner denounced the imperialism of the scientifid disciplines as "in France one denounces the imperialism of mathematics". On the other hand, Huang Shiqi writes:

> "very ridiculous follies were committed in this period (1966-76) - for example physics was taught in connection with the functioning of tractors, diesles, electric motors and water pumps at the cost of the systematic elucidation of priniples; - at a time when educators all over the world were concerned with up dating science education in schools".

Yet at present in the USA, certainly in the forefront of technological innovation, Wasser provided figures which show how the balance there has shifted from liberal academic studies to instrumental studies.

HE Students in HE	1964	1977
Academic Discipline	48.4%	42.1%
Instrumental knowledge	51.6%	57.9%

Of the instrumental studies a growing number deal with computer science. Indeed indigenous systems of vocational training are often seen as the answer to desirable and and rapid 'modernisation'.

Dore however raised important questions about relationships between scientific discoveries, technological inventions and institutional innovations.

Inventions and institution may be transferred in ways which make it possible for 'late developers' to jump a stage in the translation of general scientific principles into societal institutions. Fundamental to the success of this process is that individuals in the host country learn how to run these institutions without incurring undesired consequences. Lack of knowledge make some of the unwanted outcomes of technological innovation unavoidable.

Take for example the H bomb and its societal consequences. They certainly give strength to Donnie Lawrence's belief, quoting Douglas Sloan that peace and war issues must become the crux of all education. It is time, he argues for university dialogue to initiate the universities toward their key role of achieving peaceful aims in a world of rapid communications and transactions. Thus, methodologically technological innovation can be regarded either as a solution to perceived problems or as problem creating. Most educationists see their role as that of helping to solve rather than create societal problems.

Technological innovation as a solution

The analyses made in the 1954 (World) Year Book of Education were based on the then widely shared assumption that technological development was a, if no the, solution to a wide range of societal problems particularly those found in pre-industrialised societies and colonial territories. Many of these problems had been created by heightened expectations which were difficult to satisfy. In particular aspirations had been raised by the United Nations Declaration which laid down that everyone had the right to work and the right to education. The UNESCO Charter resolved doubts about the role of education by stating that is could ensure peace and rise in standards of living. These aspirations found expression in demands from colonial territories for independence (many of which were soon to be granted). Given the economy of many of these territories political independence did not guarantee educational or economic independence.

Post 1945 national circumstances influenced the outcomes of policies designed to promote economic growth. In many industrialised countries, particularly those of Europe and Japan first priority was given to the tasks of reconstruction. The differential rates at which recovery took place in these countries illustrate Dore's thesis that it is possible for a nation - which has pride in itself - to leapfrog other nations. Under post war circumstances impoverished nations and those facing economic reconstruction after a damaging war needed help from the USA. The Federal Republic of Germany and Japan received it. Britain's colonial territories were granted substantial aid. The USSR refused aid from capitalist countries in the form of either capital or technical assistants. Political motives influenced the extent to which rapid development was purchased at the cost of dependency. Levels of education influenced success.

Aid in the form of capital succeeded in Europe and Japan because skilled human resources were available. Successfully to transfer technology into countries where industries were poorly developed demanded (see Dore) technical assistants at one level or another and in sufficient numbers to keep the new technology working. For many years the Americans ran the oil industry in Saudi Arabia while training local personnel to do some of the jobs needed.

In the less industrialised world the speed with which policies were formulated and adopted by host countries also varied. In the process of formulating policy the recipients may be suspicious of the donors' intentions; as for the adoption of policy, opinion in the host country may be divided regarding modernisation and its effects on the possibilities of maintaining or establishing national identity and authenticity. Several references were made to this dilemma in the papers of M. Benachour, F. Mina, Mrs. Shauoam and, of course, Dore who warned that in rejecting dependency nations migth find it harder and slower to catch up. Nevertheless as Hauoam points out:

> "At the same time there was need to embark on the swiftly moving train of modernisation sweeping the world, an important condition of recognition and acceptance in a fast changing and developing world".

The dilemma for the newly indepentdent independent nations was acute. On the one hand, as Plomp made clear, that "mainly because of economic arguments such as competition, cost effectiveness and pressure from the computer and communication industry business and industry are demonstrating a 'natural affection' toward NT and its applications".

However, the transfer and implementation of new technologies without being dependent on foreign personnel depends not only on the attitudinal and behavioural changes but on the development of an adequate educational system. According to Huang Shiqi:

> "A much discussed theme in Chinese educational circles is how to carry out educational reform in the light of the nation's drive for modernization and how to make education oriented to the needs of the future and the nurture of globally minded citizens."

Thus there was, and is, a widespread desire on the part of people's everywhere to use new technologies (whether indigenous or 'borrowed') to modernise with all speed and to gear education to further this end. Implicitly such a process means the acceptance of new technology and a high tech model outlined by T. Cerdeira. But, he asks, should education be expected to respond to the technological demands of a high tech society? Cerdeira, claims with Mina, that education should not be expected to respond to the new technology but should influence the direction taken by processes of change. This view articulates very well the unwillingness of some educators to go along uncritically with the application of new technologies because they raise social and political problems. It does not respresent simple conservatism but a reasoned rejection of many features of modernising societies, and suggests that new technologies create as many problems as they solve.

Technology as problem creating

Cerdeira and others see new technologies as problem creating rather than as problem solving. In many developing countries choice of policy has itself created problems. In India Gandhi favoured a policy of rural development while Nehru wished to advance India economically through industrialisation. It is difficult to point without hesitation to a country which without an industrial infrastructure has made a great success of the application of new technologies in agriculture. Indeed in the 1954 Yearbook of Education many examples were given of the failure of Western experts to improve the economies of dependent nations through the introduction of so called 'modern' farming equipment and methods. The British groundnut and the poultry farm schemes in Taganyika and Gambia were disastrous failures. Attempts to clear the bush in Nigeria to provide more land for farmers were equally unsuccessful. 'Modern' methods of farming in India required a chemical industry capable of manufacturing artificial manures in quantities beyond the capacity of India's industries. 'Modern' farming has thrived, noticeably in Denmark during the nineteenth century, where there already exists a well established educational system. The same can be said of the USA and Canada where fast ripening corn has been successfully introduced; and of New Zealand where the production of lamb for the European market was encouraged by the introduction of refrigerated ships.

On the whole farming communities either successfully resist the introduction of new technology or find that without an industrial infrastructure and a well developed formal system of education the introduction of new machines, methods of intensive crop raising, new plants and the like raise problems which have rarely been solved. The problems created by these innovations have been and are still all too obvious.

One reason for these failures as Dore reminded us is the unwillingness of Third World countries to accept from donors anything less than the latest and the best kinds of technology. In some cases, it is necessary. For example in the oil rich nations the most advanced technology is needed if development is to take place. Even so success is not inevitable. The OPEC nations have succeeded in a way that perhaps has eluded Nigeria. On the other hand late starters in the process of industrial development have overtaken pioneers like Britain and even to some extent Germany. Japan and Korea are examples of such late starters.

The problems created by the successful introduction of new technologies in these countries are less obvious than in agricultural countries. It should be noted however that rapid industrial growth may well lead to political instability. The economic success achieved by the Japanese after 1868 may have been the forerunner of the ultra militarism of the 1930's. Economic recovery in the pre world war II Germany may have been promoted by and contributed to the rise of Hitler. It is hard to say - but the political problems arising from the application of new technologies in industry should not be overlooked.

Other problems are all too evident. Against the commitment that everyone has the rigth to work, levels of unemployment in the industrialised countries are now unacceptably high. At the same time there may be available jobs which cannot be filled because they require highly skilled personnel. The aspirations of women, partly promoted by their introduction into industry in times of war, have changed. They wish to enjoy the same right to work as men. As Sutherland points out however the opportunities enjoyed by women are more restricted than for men in spite of programmes devised in Greece for example, to initiate "women into jobs traditionally reserved for men" and in the Netherlands to "encourage girls to take training courses that have traditionally been a male reserve". With many men out of work the position of women is made more serious than it might otherwise have been. Enough was said during the conference to confirm that while there is no agreement on the desirability of pressing ahead with technological innovations regardless of their consequences it was clearly recognised that in spite of reservations the introduction of new information technology, in its many forms had created an information society. As W. Decoo pointed out in a spirited defence of them, teachers, had helped to create the information society as the result of the role of education in a dynamic relationship. If this is the case then changes in educational systems too can be seen as problem creating. In any case, it is certainly true that during the conference considerable attention was paid to the implications for educational systems of new information technology and the information society. Again the range of the discussions, in spite of the admirable framework provided by the Dutch Speaking Society, is too great for me to do justice to it. Consequently I propose, again selectively, to place frequently conflicting comments about education, schools and teachers within the taxonomy accepted by the International Bureau of Education.

Aims and Objectives

Certainly the information society has created problems educators are expected to solve. Most people probably agreed with Joseph Katz when he commented that in the information society everybody was overwhelmed by the mass of information available and the power of the media to deliver and disseminate it. At the same time the fascination technology has for children and young adults frequently places them ahead of their teachers and makes it necessary according to Edmund King for us to take an example form young adults in our appraisal of the use to which information can be put. This theme, as Dore stated is not new. A hundred years ago Matthew Arnold in Culture and Anarchy pointed to the same dilemma at the onset of the information society. Nevertheless it remains a dilemma for educationists. Wheter teachers are clear enough in their aims and objectives to know what they want to teach and what machines they should select were major issues on which participants were not agreed.

Yet at the most general level of discussion there was clear agreement that in the present day information society child, society and knowledge centred educational aims should be pursued simultaneaously. Whether such a reconciliation is possible is less certain. For example much was made of the need to prepare individuals for work - especially specialists for industry - while at the same time it was necessary to prepare them for increases in the amount of leisure time available to them throughout their lives. At the same time, it was argued, education should liberate individuals by disseminating information, rather than marginalising them, to ensure their autonomous development.

The key, as always, to the reconciliation of child and society centred aims lies in knowledge, meaning and understanding. According to Mitter, in his opening remarks, information technology directs attention to a new knowledge centred approach to (or aim for) education. Indeed Plomp suggested that the new information technology has had an impact on the general goals of education. This may be so if a distinction is made between the general aims and more specific goals and objectives of education. The former, as we have seen, include child and society centred aims. Knowledge makes it possible to reconcile them. What is clear, however, is that knowledge centred aims and objectives need to recognise that the traditional school has lost its monopoly on the delivery system of knowledge in ways similar to those brought about earlier by the introduction of printing and books. One consequence of this loss is that the relationship between teachers and pupils is in process of change. Students can be more independent of teachers but may, at the same time, become more dependent on the mass media of information. Traditional teachers may find this new independence difficult to accept.

Hence questions arise: Are teachers useless or redundant? If they are not, have they a new role to play? And if so, what is that role? Traditionally their task has been to select from the accumulated knowledge of mankind that inforamtion they considered should be passed on to a new generation. They decided, moreover, to whom it should be given. The power of teachers to control the distribution of knowledge has been largely removed in the new information society. Several speakers, were nevertheless reluctant to concede that, in the face of the mass of information available, teachers were impotent, useless or redundant. Several answers were given to the question: How should their role change? The main thrust of these answers was that teachers should no longer regard themselves as the guardians of knowledge to be distributed in accordance to their whim or judgement, but that they should regard their role as that of teaching young people how to 'learn how to learn' and provide them with the skills which would enable them how to identify their own problems and how to solve them.

What are these basic skills which teachers can incalculate? In the past, and even now in many countries, a major objective for teachers was to provide their pupils with literacy skills and then to decide what they should read and how they should write. There was a good deal of discussion about whether or not computer literacy should be added to the traditional 3 RS as the goal teachers should seek to achieve. Associated with computer literacy are many of the characteristics associated with traditional literacy - awareness, appreciation, familiarization with the application of computers, their capabilities and limitations in order to demystify them: for computers read traditional 'books' the appreciation, and limitations of which require an ability to read if not to write. However, the introduction of computer literacy as a task for schools was not universally agreed. The view of an MIT scholar was quoted. He questionned whether computer literacy should be a school objective in spite of the warning of H. Noah that unless individuals are computer liberated, the use of computers by the State may help to enslave individuals and deny some of them their human rights.

To look at the aims and objectives of education it is necessary to look beyond the first second and even third levels of education, to a system of life long permanent and recurrent education. And indeed to ask whether the aims of what has been known as general and vocational education should be the same. In the present climate of opinion many would agree with I.R. Marin that the principal aim of formal education should be to prepare its recipients for life - in terms of further education, work, leisure, family life, and civic participation if the formula of Herbert Spencer and the pragmatists is to be accepted, providing, again from Marin, that the all round development of individuals and their personality should not be sacrificed. Not an easy task since as several speakers maintained, since machines themselves reduce the autonomy of individuals.

As usual, uncertainty about goals and objectives gave rise to a measure of consensus on some vague (but important) general principlies which might well have been stated at the time the first information society was inaugurated when books became widely available. It was agreed that teachers should teach pupils how to handle the mass of information made available to them, given that they can see and hear (without necessarily being able to read), in present day societies. Hence considerable attention was paid to the goal of 'learning how to learn' and to the acquisition of problem solving skills and the role teachers could and should play in the achievement of them. Little mention was made of the role teachers should play in the selection of information and in the selection of pupils to whom such knowledge should be given. All pupils apparently should be taught how to handle information and no suggestion was made that some of them may be more capable than others of doing so. Indeed one of the hopes embraced by those who discussed the implication of the information society is that the educational process will become completely equalitarian given that computers, like books before them, can be introduced into every educational institution. To make operational sense of this goal all pupils should be taught how to select and use the knowledge they need to solve problems they face or are likely to face when they are no longer attending an institution of formal education.

Such an approach, which is basically in line with what John Dewey was saying at the start of the twentieth centruy, shifts the emphasis from passing on accumulated wisdom and knowledge to an approach which stresses the goal of teaching pupils how to think reflectively. Content has been replaced by process and the implications for teachers are tremendous. The most important is that in the process of realising new educational goals and objectives deeply held beliefs and behaviour patterns will have to be changed - not least by teachers themselves. Much attention was paid during the conference to the possibilities of breaking this vicious circle.

If it is assumed that the general aim of education is to prepare people for life by showing them how to tackle and solve their own problems without denying them the chance to develop themselves fully as human beings (whatever that may mean) the role of information technology in schools and other educational institutions can be considered. The difficulties of using new information technology to solve some of the problems it has created in society at large were also central to the debate which took place in the commissions and in the discussions which followed the plenary speeches.

The achievement of new goals, however, depends upon the availability of resources ultimately measured in financial terms, the administrative arrangements which facilitate innovation, including curriculum development, the organisation of school systems, teaching methods and teacher training. Each of these aspects of education was discussed by reference to the introduction of new information technologies into schools. The use of computers in school was held by some participants, to be a way of solving some of the problems created by new information technology in society. At the same time the introduction of computers into schools was seen as creating many pedagogical problems. Computers in schools are both problem solving and problem creating innovations.

Innovation, administration and finance

The literature on educational innovations is extensive. It was developed to a great extent during the 1960s by individual authors and OECD through the work of CERI. Of particular concern at the conference were the administrative devices that can and have been used to introduce new information technology into schools. Particular attention was paid to how computers could be introduced into first and second schools.

Just as traditional forms of literacy required the introduction of books into schools so implicit in the notion of teaching computer literacy is the requirement that computers should be brought into every school. For some their introduction has been seen as a panacea, for others this innovation has raised innumerable problems within educational systems.

One issue which aroused considerable discussion turned on the perennial debate about the effectiveness of centrally promoted innovations compared with innovations introduced by teachers themselves or by members of local educational authorities. The issue was stated in several ways. Some participants talked of 'grass roots strategies', others of 'top-down strategies' and others spoke of the need in decentralised systems to equalise opportunities by ensuring that all schools in the system possessed the same facilities. It was made clear, moreover, that the introduction of computers into schools had important international implications. Noah made the point that there are differences in the capacity to use efficiently existing technologies. Lessons, it was claimed, could be learned from the difficulties which had been experienced when older technological aids - like overhead projectors, film strips and motion pictures - had been introduced as teaching aids. Then, as now, many developing countries wishing to introduce the latest technology into their schools are dependent for hard and soft-ware on the industrialised countries. In their desire to leapfrog some of the stages of development through which the industrialised nations have passed they are in fact prepared to enter into agreements which increase their dependency.

However, a more sophisticated analysis of the processes of innovation is necessary if the successes and failures of technological innovation in schools are to be evaluated. A distinction should be drawn between processes of policy formulation, adoption and implementation. Competition helps to persuade national governments, local authorities and even those in charge of schools to decide that computers should be introduced into primary and secondary schools. At one level such a policy may be adopted and even welcomed by many actors in the educational enterprise. Several speakers emphasised that the successful introduction of new technologies takes time: - A. Louwyck suggested five or six years. Denis Kallen mentioned the differential take up of innovation resulting in a scientifically literate elite and, in this sense, illiterate masses. National governments can decide to introduce computers and subject to the necessary finance this might be done, although of interest was the account given of the Belgian experimental snowball innovation strategy. In many countries hardware has been made available and computers have been introduced into many schools either as a top-down strategy or through local initiatives.

All were agreed that difficulties arose in the pedagogically successful implementation of computers as educational solutions. Hence a good deal of the discussion turned on the preparation of software and the implications computers had for various subjects.

Implementation, curricula and teaching methods

Several speakers offered explanations why governments and some international agencies have accepted computers as an educational panacea, facilitating economic growth and the achievement of education for all. N. Raivola saw educational changes, including a system of computer assisted learning as "not planned but reaction to change that has been initiated somewhere else". For the most part, in spite of differences in the willingness of governments in Europe. North America and the Third World (as mentioned by G. Kerewala and Franseco Pedro Garcia the 'we must not fall behind our competitors' syndrome was persuasive. Other explanations were offered. B. Makrakis suggested that since information technology is closely related to economic development the efficiency of an educational system may be measured "in responding and adapting itself to the new demands of the information society". P. Döbricht went further by suggesting that for some policy formulators a new educational crisis is forecasted if there is no rapid introduction of computer literacy. Thus although some educational innovations may not be universally adopted in contrast as Plomp indicated to the immediate acceptance of computers in business, some industries and the home, climates of opinion were increasingly favourable to the use in schools of new as old technologies. The lesson learned about the introduction of old technologies, are, however, relevant to the successful implementation of new technological teaching aids. Adoption of a policy does not, from a social psychological viewpoint necessarily imply that it will be successfully implemented.

Indeed, one of the most important lessons to be learned, mentioned by Cerych in a somewhat different context, is the time that it takes for individuals so to internalise an innovation that they can use it effectively. By the same token it might meet resistance. The unwillingness of religious leaders in some developing countries with a vested interest in maintaining the status quo was mentioned by G. Saqeb as one reason why it took so long for the majority of teachers to internalise an innovation. D. Lancy's opening statement illustrates a general dilemma well:

> "Many of us who have served as teachers/consultants/advocates for introducing computers into schools are saddened and frustrated by what appears to be a tremendous confusion, even conflict, surrounding the process."

Members of the Dutch speaking panel brought the issue to a head when its opening speaker made three propositions for discussion. They turned on the willingness and ability of teachers to implement policies associated with the introduction of new technologies into classrooms. The speaker made three claims. In summary they were. First that schools are not in a position to prepare pupils for an information society; second that teachers were not capable of implementing information technology; and third that that the examples and analyses provided by guest speakers strengthened these claims. A lively discussion followed, during which Kallen asked whether in attempting to prove themselves schools may fail to prevent boredom and alienation and whether computers might not demotivate teachers and pupils and dehumanise the system. Plomp advanced the view that if teachers were to prepare pupils for the information society innovations must be in response to their perception of a need (and presumably not all teachers feel the need for computers); the proposed changes must be clear to them; and the need should be seen to be practical. Changes associated with the introduction of new technology had not been made clear enough to teachers nor had the quality and practicality of the programmes been demonstrated. Consequently some teachers are not interested in computers. H. Kremers answered the implied questions by stating that since most teachers are not very familiar with information technology they are not in a position to prepare pupils for the information society. He pointed out that most teachers had been brought up in a particular tradition and information technology through data bank processing was taking over from them. Evidently one view was that teachers are neither willing nor capable of preparing pupils for the information society.

Fr. Daems illustrated a not uncommon situation by saying that the authorities in Flanders wished to introduce information technology into secondary schools for 15-16 year old pupils by creating a new discipline or subject which would include reflections on the implications of information technology. He mentioned some serious drawbacks which were not directly related to the ability or willingness of teachers. For example the new information technology was not integrated into the curriculum. The educational authorities had shown little interest in the educational issues associated with computer assisted learning and there was a shortage of good software. He concluded that teachers were not to blame and reported that many were preparing themselves by developing course work. As stated, Louwyck made the point that to prepare teachers for the new technology took time and that the expectations of government cannot be reached until clear decisions had been made about whether information technology should be a special discipline or a general component of the curriculum. Decoo rounding up for the defenders of teachers stated categorically that the opening statements were untrue, that teachers were not te be blamed and that many of them using computers were doing their best to improve education.

Clearly on these quite fundamental issues there was no consensus. At the same time no empirical evidence was provided which might have helped participants to reach an assessment other than on the basis of opinion. It is a weakness in comparative research that on such matters empirical evidence has not been collected and that among comparative educationists statements of opinion have to suffice.

They are able to express concern and few participants disagreed that the lack of good quality software which was interchangeable created serious difficulties. It was agreed that there was need for initial and in-service training for teachers who would be expected to implement policies frequently formulated and adopted by governments on grounds which were not really pedagogical. Speakers from Iran and Brazel commented on several of the issues raised by the panel and reported on reform movements in their own countries. Marin perhaps summed up the discussion by saying that even if teachers were not prepared, or willing, to use new technology successfully there were enormous problems associated with changing their attitudes and preparing them for the task of initiating pupils into the information society.

It was hardly surprising therefore that among the many issues discussed in the six working commissions the application of new technologies in teh teaching of specific subjects and their integration into curricula as a whole received considerable attention. Many of the comments made in discussion and in the commission reports were general in nature and identified problems more frequently than they described authenticated successes. Examples were given of reform movements in Greece, experiments in Africa and Europe and the dangers of increasing dependency in the technological and information society. Analyses were made of the availability and quality of software in various systems of education and relations between technology and the fine arts received considerable attention in the deliberations of at least one commission. Also discussed as a curriculum issue were what relationships should be established between general education and education for a career in the information society. In particular competers and literacy, computers in science and mathematics and computers as offering new ways of presenting accepted art were discussed in some depth.

These discussions and the papers presented before the conference, suggest the balance of interest and expertise existing among participants, in the theme of the conference. Nineteen papers delat with theoretical models and introduced cross disciplinary dimensions to the theme. A majority (32 papers) of papers concentrated on innovations and problems in a single country in ways that added information to data on the theme. Twenty three papers, which might be regarded as satisfactory in such a conference, provided a comparative perspective in an explicit and direct manner. Of these some nine were about Western countries; three dealt with West and East Europe; six were about education in developing countries; and five provided overreaching accounts of cross cultural similarities and differences.

Certainly a mass of information was added to the analysis of the theme but it is clear that in the wide ranging discussions an identifiable comparative education research methodology could not be discerned, nor was much hard data shared equally among all participants, and finally there was no consensus of opinion on matters which were advanced as matters of opinion. Although many research studies were quoted and examples of successful and unsuccessful innovations were described much that was said was informed by political, sociological and pedagogical ideology and little was legitimized by reference to well founded empirical evidence. Apparently even in such a well organised conference as this, comparative educationists do not yet share an accepted basis of knowledge based on research. They speak for the most part as philosophers or at wordt ideologues. Gone apparently are the days when, as in 1961, CESE was founded, most if not all participants shared common assumptions about ways of conducting comparative education research and as philosopher-historians broadly speaking discussed on the basis of shared information about educational systems and the historical origins of them.

Perhaps it was because, though not by intention, members of the 1961 meeting were heavily European centred in their outlook and approach to comparative education. Certainly this could not be said of the conference in Antwerp yet a kind of European imperialism or nea colonialism prevailed without the emergence of a new consensus among comparative educationists.

There was, however, agreement that in the inforamtion society, whose characteristics were left suitably vague, a major pedagogical issue turned on the possibilities of teaching young people (and possibly through life-long education all individuals) how to handle information. I think Raivola summed up the situation reached rather well:

> "The key issue in future education is not technology itself but change, of which technology is only a part. Education must prepare us socio-politically for a new society as it had to do 150 years ago."

Which, as I stated earlier, is "where I came in" in 1954.

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